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ABSTRACT

This learning packet, one in a group of eight, was developed by the Morrow Mountain State Park in North Carolina for Grades 5-7 to teach about the identification and formation of rocks. Loose-leaf pages are presented in 10 sections that contain: (1) introductions to the North Carolina State Park System, the Morrow Mountain State Park, and to the park's activity packet; (2) a summary of the activities that includes major concepts and objectives covered; (3) pre-visit activities on sedimentary, metamorphic, and igneous rock formation; (4) on-site activities on rock classification and erosion; (5) post-visit activities designed to reinforce and review previous lessons; (6) a list of 44 related vocabulary words; (7) a summary of the Uwharrie Mountains Geology; (8) necessary park and parental permission forms for the visit; and (9) blank pages for taking notes. Contains 16 references and includes a separate educator's guide. (MDH)

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Morrow Mountain State Park

An Environmental Education Learning Experience

Designed for Grades 5-7

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OLD AS

THE HILLS

Morrow Mountain State Park

An Environmental Education Learning Experience

Designed for Grades 5-7

"Rocks and clay are part of the Mother. They emerge in various forms, but at some time before, they were smaller particles of great boulders. At a later time they may again become what they once were. Dust."

Leslie Marmon Silko, b. 1948
American Writer

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Introduction to the North Carolina State Parks System

Preserving and protecting North Carolina's natural resources is actually a relatively new idea. The seeds of the conservation movement were planted early in the 20th century when citizens were alerted to the devastation of Mount Mitchell. Logging was destroying a well-known landmark - the highest peak east of the Mississippi. As the magnificent forests of this mile-high peak fell to the lumbermen's axe, alarmed citizens began to voice their opinions. Governor Locke Craig joined them in their efforts to save Mount Mitchell. Together they convinced the legislature to pass a bill establishing Mount Mitchell as the first state park.

That was in 1915. The North Carolina State Parks System has now been established for more than three-quarters of a century. What started out as one small plot of public land has grown into 59 properties across the state, including parks, recreation

areas, trails, rivers, lakes and natural areas. This vast network of land boasts some of the most beautiful scenery in the world and offers endless recreation opportunities. But our state parks system offers much more than scenery and recreation. Our lands and waters contain unique and valuable archaeological, geological and biological resources that are important parts of our natural heritage.

As one of North Carolina's principal conservation agencies, the Division of Parks and Recreation is responsible for the more than 125,000 acres that make up our state parks system. The Division manages these resources for the safe enjoyment of the public, and protects and preserves them as a part of the heritage we will pass on to generations to come.

An important component of our stewardship of these lands is education. Through our interpretation and environmental education services, the Division of Parks and Recreation strives to offer enlightening programs which lead to an understanding and appreciation of our natural resources. The goal of our environmental education program is to generate an awareness in all individuals which cultivates responsible stewardship of the earth.

For more information contact:

NC Division of Parks and Recreation
P.O. Box 27687
Raleigh, NC 27611-7687
919/ 733-PARK

Introduction to Morrow Mountain State Park

First-time visitors to Morrow Mountain State Park are often surprised to find such mountainous terrain in south-central North Carolina. The Uwharrie Mountains lie on the eastern edge of the Piedmont plateau, forming a barrier of steep hills and ridges between the Coastal Plain and the gently rolling Piedmont.

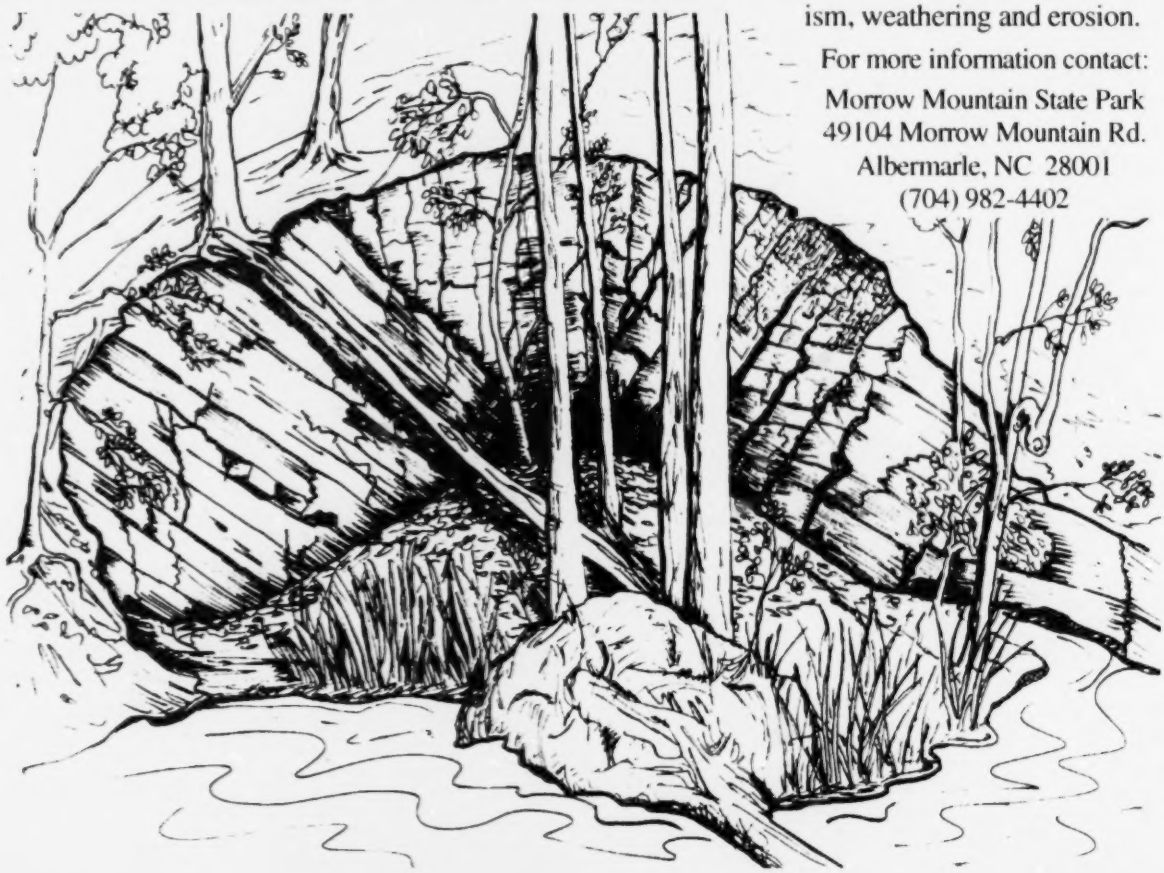
The Uwharrie Mountains, of which Morrow Mountain State Park is a small part, were formed over 500 million years ago. At that time, this area was a flat sea. Weak places in the ocean floor began to spew forth lava, that built up, and eventually gave rise to the Uwharries. Today these mountains appear as rounded, gently sloping hills.

In the 1930's, a local committee began to generate interest in a state park in the area. By 1937, the committee had acquired more than 3,000 acres of land, much of it donated by the citizens of Stanly County. As a result of their efforts, Morrow Mountain State Park was opened to the public in the summer of 1939. Early development was a cooperative effort of the Civilian Conservation Corps and the Work Projects Administration. Work crews constructed many of the park's facilities, including the stone bathhouse. Today, the park comprises almost 5,000 acres of the Uwharrie landscape.

Morrow Mountain State Park affords the student the opportunity to study two of the three basic rock types (metamorphic and igneous) and the geological processes of mountain building, volcanism, weathering and erosion.

For more information contact:

Morrow Mountain State Park
49104 Morrow Mountain Rd.
Albermarle, NC 28001
(704) 982-4402



Introduction to the Activity Packet for Morrow Mountain State Park

The Environmental Education Learning Experience (EELE), Old as the Hills, was developed to provide environmental education through a series of hands-on activities geared to Morrow Mountain State Park. This activity packet is designed to introduce the student to the geology of the Uwharrie Mountains. It is targeted for the 5th through 7th grades and meets established curriculum objectives of the North Carolina Department of Public Instruction.

There are three types of activities in this packet; pre-visit activities, on-site activities and post-visit activities. On-site activities will be conducted at the park, while pre-visit and post-visit activities are designed for the classroom environment. Pre-visit activities should be introduced prior to the park visit so the students will have the necessary background and vocabulary for the on-site activities. We encourage you to use the post-visit activities to reinforce concepts, skills and vocabulary learned in the pre-visit and on-site activities. These activities may be performed independently or in a series to build upon the students' newly gained knowledge and experiences.

The environmental education learning experience, Old as the Hills, will expose students to the following major concepts:

Weathering
Erosion
Rock cycle
Rock types
Geologic processes

Vocabulary words used throughout this environmental education learning experience appear in **bold type** the first time they are used in an activity. Their definitions are listed in the back of the activity packet. A list of reference materials used in developing the activities follows the vocabulary list. A summary of the geology of the Uwharrie Mountains is also located at the end of this activity packet.

To make these learning experiences on geological processes more effective, we encourage the students to create a notebook of all their activities, drawings and worksheets.

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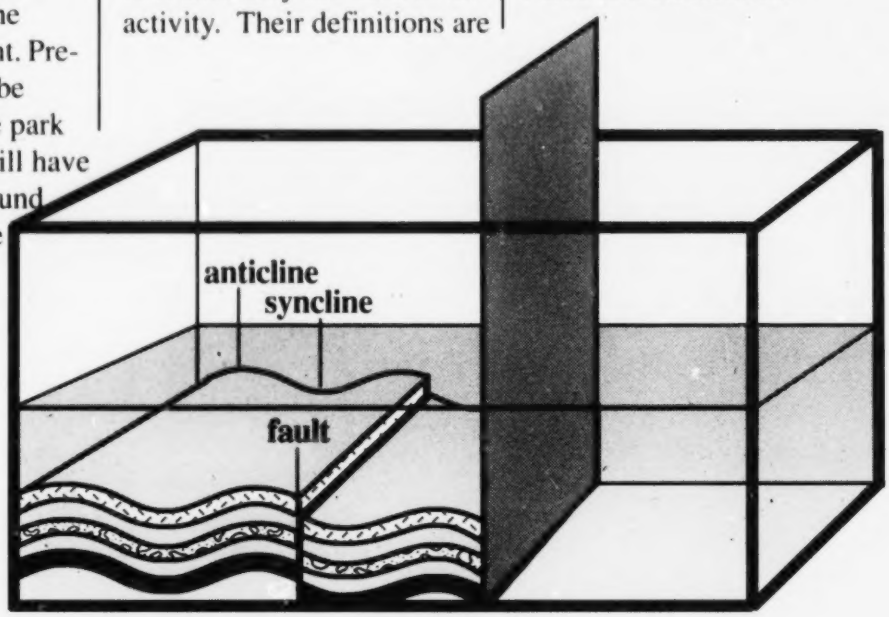


Illustration of Pre-Visit Activity #1– **Layer On Layer**.

Activity Summary

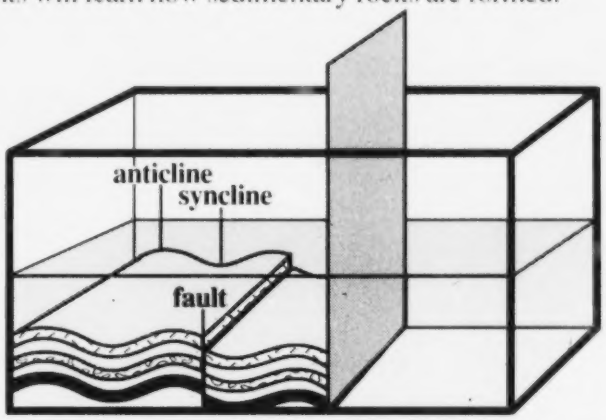
The following outline provides a brief summary of each activity, the major concepts introduced and the objectives met by completion of the activity.

I. Pre-Visit Activities

The pre-visit activities are designed to introduce the student to the different rock types: sedimentary, igneous and metamorphic. Students will also learn how these rocks are formed, how to recognize them and how they erode.

#1 Layer On Layer (page 3.1)

Through layering soils into water, students will learn how sedimentary rocks are formed.



Major Concepts:

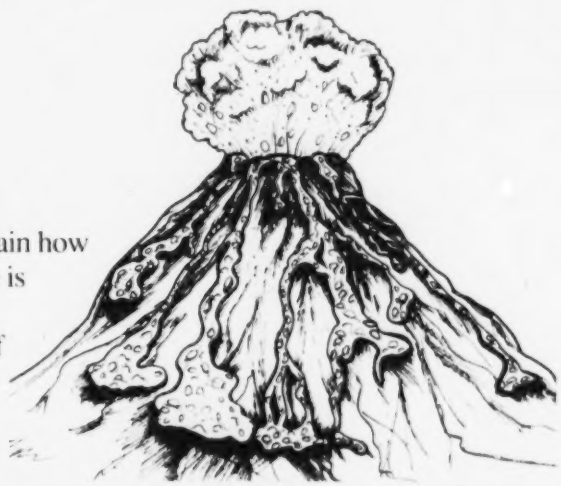
- Sedimentary rock formation
- Sedimentation

Objectives:

- Describe how sedimentary rock is formed and list three typical soils that make up sedimentary rock.
- Describe how metamorphic rock is made from sedimentary rock.
- Describe what happens to rock when powerful forces within the earth begin to shift, move and compress sediments.

#2 Cooking, Volcano Style (page 3.2)

Through making peanut brittle, students will learn how igneous rock is formed.



Major Concepts:

- Igneous rock formation
- Lava
- Magma

Objectives:

- Name the two types of igneous rocks, explain how they are formed, and determine which type is found at Morrow Mountain State Park.
- Name the primary force in the formation of igneous rock.
- Define whether the process causing the formation of igneous rocks changes the rock structure, composition or both.

#3 Hard Rock Crayola (page 3.3)

Through this activity students will learn how sedimentary, metamorphic and igneous rocks are formed and will be introduced to the rock cycle.

Major Concepts:

- Rock cycle
- Mechanical weathering
- Sedimentary rock formation
- Metamorphic rock formation
- Igneous rock formation

Objectives:

- List the three main rock types.
- Describe how these three rock types are formed.
- Explain the rock cycle.
- Describe four processes by which one rock type changes into another.
- Name a metamorphic and an igneous rock found in the park.

#4 Cracking Up (page 3.4)

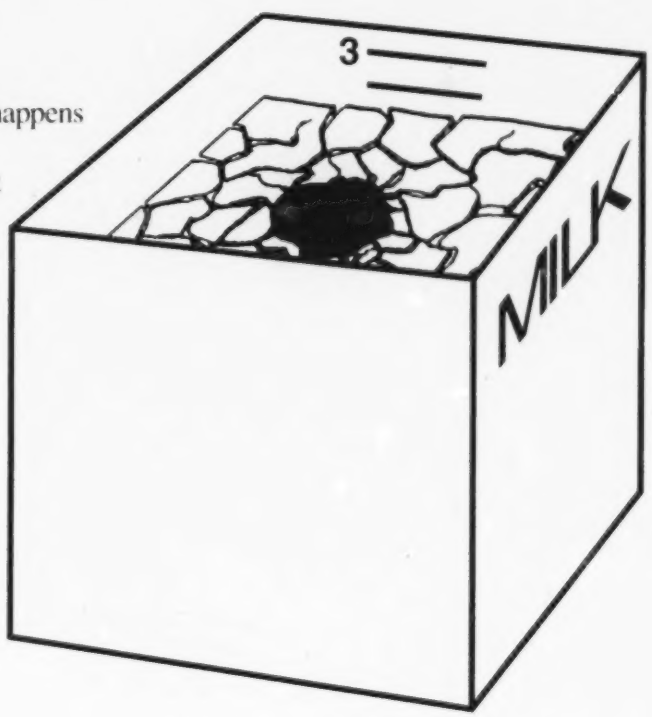
Through this activity, students will learn the importance of freezing water in the breaking down of rocks.

Major Concepts:

- Weathering
- Environmental changes
- Erosion
- Hypothesis testing

Objectives:

- Write and test hypotheses on what happens to water when it freezes.
- State what happens to water when it freezes and how the freezing of water can shape the land.
- Explain how sediments suspended in water or ice shape the land.



II. On-Site Activities

The on-site activities are designed to familiarize the student with the specific rock types of the Uwharrie Mountains, their characteristics and where they are found in the park. Before coming to the park, students and educators should read the Summary of the Geology of the Uwharrie Mountains in the appendix.

#1 Rock ID (page 4.1)

Through this activity, students will be able to identify and name the characteristics of five different rocks found in the park.

Major Concepts:

- Rock formation
- Rock characteristics
- Sedimentary, metamorphic and igneous rocks

Objectives:

- Identify the major rock types found at Morrow Mountain State Park and determine their origin.
- Identify three different types of rock found in the park by listing their distinguishing characteristics.
- List five rock characteristics that geologists use to help in the identification process.

#2 Water Over The Rocks (page 4.2)

On a geological hike through a quarry located in the park, the students will observe firsthand the effects of geologic processes on the landscape.

Major Concepts:

- Erosion
- Water cycle
- Rock cycle
- Use of stone

Objectives:

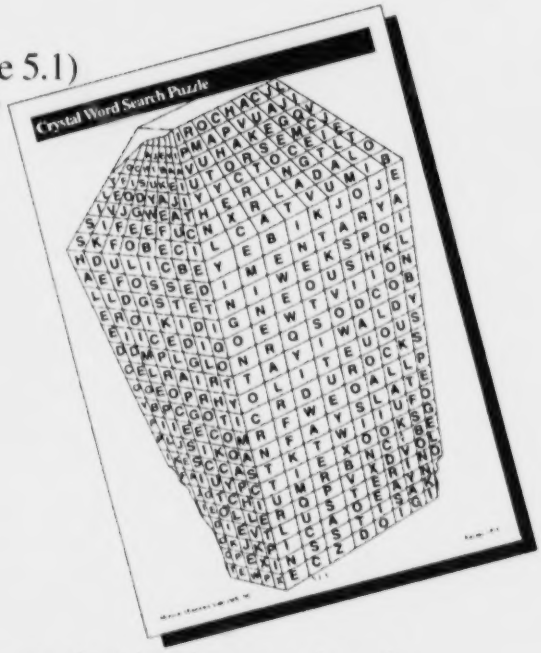
- Name one natural and one unnatural thing that have greatly affected the weathering of the rocks in the park.
- Explain how metamorphic rock is formed and name one common to this area.
- Explain how sedimentary rocks are formed and how they are layered.
- Explain why rocks found in this area are no longer in a horizontal plane.
- Classify at least two rock positions found in the quarry.
- Observe and record the effects of moving water on rock surfaces.
- Name the type of stone used for building material in the park and explain why it was used.

III. Post-Visit Activities

The post-visit activities are designed to reinforce and review previous lessons, and to broaden the student's understanding of geology.

#1 What's Your Crystalline Structure? (page 5.1)

This activity will reinforce the geological vocabulary to which the students have been exposed.



Major Concepts:

- Geologic processes
- Geologic cycle
- Vocabulary

Objectives:

- Name the three basic rock types and explain how they are formed.
- List two geologic processes.
- Describe what a rock is and name two rocks common to this area.

#2 Geology Jeopardy (page 5.2)

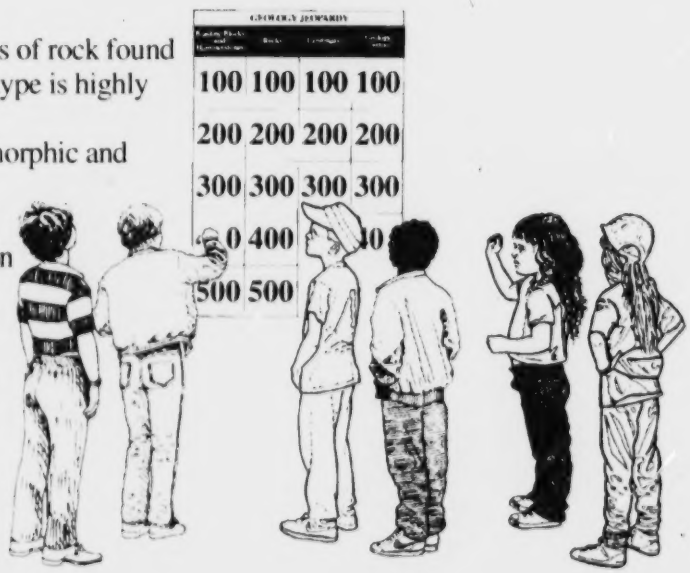
Through participation in this geological version of the popular television game show, the important concepts, facts and processes covered in this entire activity packet will be reinforced.

Major Concepts:

- Rock formations
- Landforms
- Rock composition
- Use of native stone

Objectives:

- List the three most common types of rock found in the park and state which rock type is highly resistant to erosion.
- Explain how sedimentary, metamorphic and igneous rocks are formed.
- Name two rock types and how they have been used by humans in this area.



Pre-Visit Activity #1 — Layer on Layer

Curriculum Objectives:

Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: group cooperation
- Science: earth science
- Social Science: organize and analyze information, draw conclusions, participation

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: group interaction
- Science: earth science
- Social Studies: gather, organize and analyze information, draw conclusions

Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: being responsible in a group
- Science: soils
- Social Studies: gather, organize and analyze information, draw conclusions

Location:
Classroom

Group Size:
30 or less

Estimated Time:
One hour

Materials:
Provided by the educator: small aquarium, 2-liter clear plastic soda bottles with the tops cut off (one per group), sand*, clay*, water and leaves
Per student: "Layer on Layer" worksheet, pencil

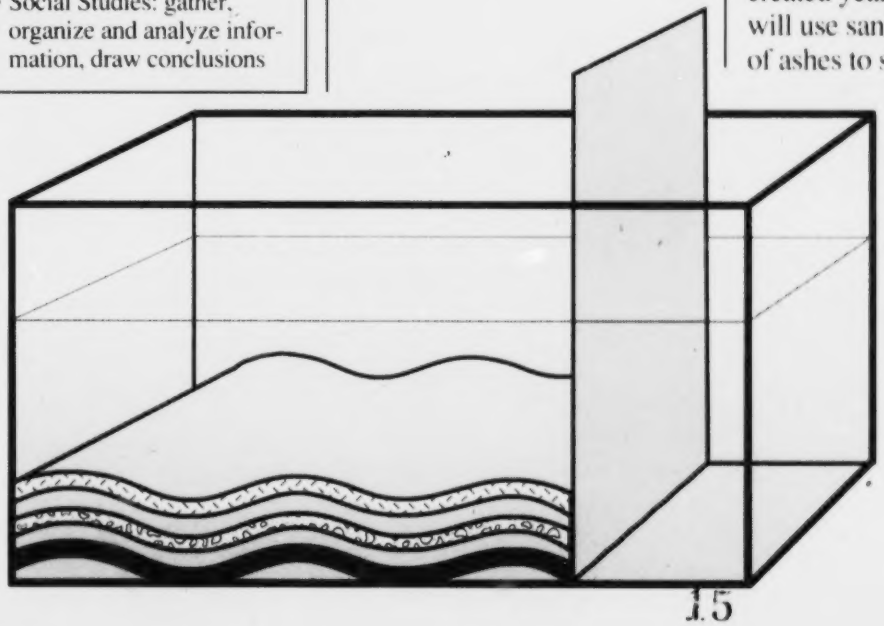
(*Any type of fine material that will settle in water can be used for the sand and the clay. Preferably, the materials should be of several different colors so the layering effect can easily be seen. Powdered paints mixed with plaster of Paris, sand, etc., could be used. Make sure none float.)

Major Concepts:
- Sedimentary rock formation
- Sedimentation

Objectives:
- Describe how sedimentary rock is formed and list three typical soils that make up sedimentary rock.
- Describe how metamorphic rock is made from sedimentary rock.
- Describe what happens to rock when powerful forces within the earth begin to shift, move and compress sediments.

Educator's Information:

During this activity, the students will create their own sedimentary layers in much the same way they were created years ago. The students will use sand and clay instead of ashes to show layering.



Student's Information:

Sedimentary rock can be formed in a variety of ways. Running water, such as a river, will deposit **sediments** along flood plains and deltas. **Volcanoes** spew out ash which will settle on land or bodies of water. Under the proper conditions, such as enough heat and pressure, these sediments will become sedimentary **rock**. When exposed to even greater extremes of heat and pressure, sedimentary rock can become **metamorphic rock**.

Geologists have found evidence deep in the earth that the Uwharrie Mountains were once a flat sea bottom. This tranquil sea was disturbed by powerful forces within the earth that began to cause changes 500 million years ago. The changes caused volcanoes to form, spewing ash and **lava**. For millions of years, ash from these volcanoes fell into the surrounding sea and slowly settled into sediment layers thousands of feet thick. In time, due to the crushing weight of the sea above them and the ever increasing depth of the sediments, the layers of ash turned into a soft sedimentary rock called **shale**. The extreme pressure eventually caused the shale, at the layers deepest in the sea, (over 6 miles) to be changed, or metamorphosed, into a harder rock called **argillite**, which is a type of **slate**.

slate

Slate (argillite) can be found within the park. Some of the metamorphosed slate has reverted back to a soft, brownish colored rock known as weathered argillite (or weathered slate). This has occurred as 6 miles of earth and rock above the slate eroded away. This **erosion** greatly lessened the pressure that had been on the slate and exposed it to **weathering**. Weathered argillite is sometimes mistakenly called shale. Although weathered argillite appears much like shale, shale is a sedimentary rock, whereas the weathered argillite, a rotten slate, is a metamorphic rock.

weathered slate

After the slate-forming era, pressure from inside the earth caused much uplifting of the slate layers. These layers are seldom found in a horizontal position, even though that is the way they were formed. Instead they are **folded**, tilted, broken and **faulted** to the extent that the layers visible in the park's abandoned quarry are tilted nearly vertical!

Folded rocks have two common forms in this area. The folds which are basin-like, or bowl shaped are called **synclines**. The ones that are hill-like or humped are called **anticlines** (see Figure 1).

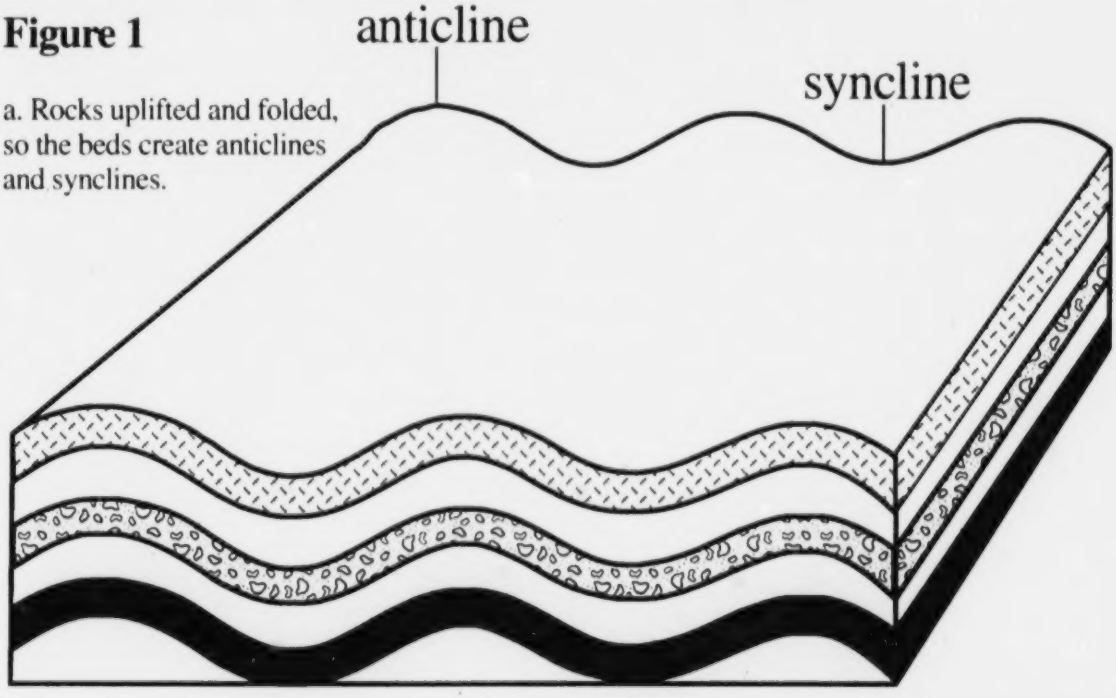
Sedimentary rock and metamorphosed sedimentary rock are the rock types in which fossils of plants and animals are found. Fossils are formed in a process where plants and animals are surrounded by silt. The organic material is then slowly changed chemically to a rock-type matrix. However, fossils are rarely found in the weathered argillite and slate of this area for several reasons. The rocks are very old (approximately 500 million years), which means that when these rocks were forming, life was restricted to oceans and rivers. Also, most of these life forms were bodied, so they did not fossilize well. However, against all odds, three fossils have been found in slate in Stanly County. All three fossils are of an animal called a **pteridinium**. There are deposits of slate in Morrow Mountain State Park but fossils have

not been found in them. When you visit the park, look for fossils in the rocks, you might be extremely lucky!

Both the slate and weathered slate rock are easily seen in the park along the creek beds, road cuts and in the abandoned flagstone quarry.

Figure 1

a. Rocks uplifted and folded, so the beds create anticlines and synclines.



b. Rock uplifted and tilted so the beds are at an angle or tilt.

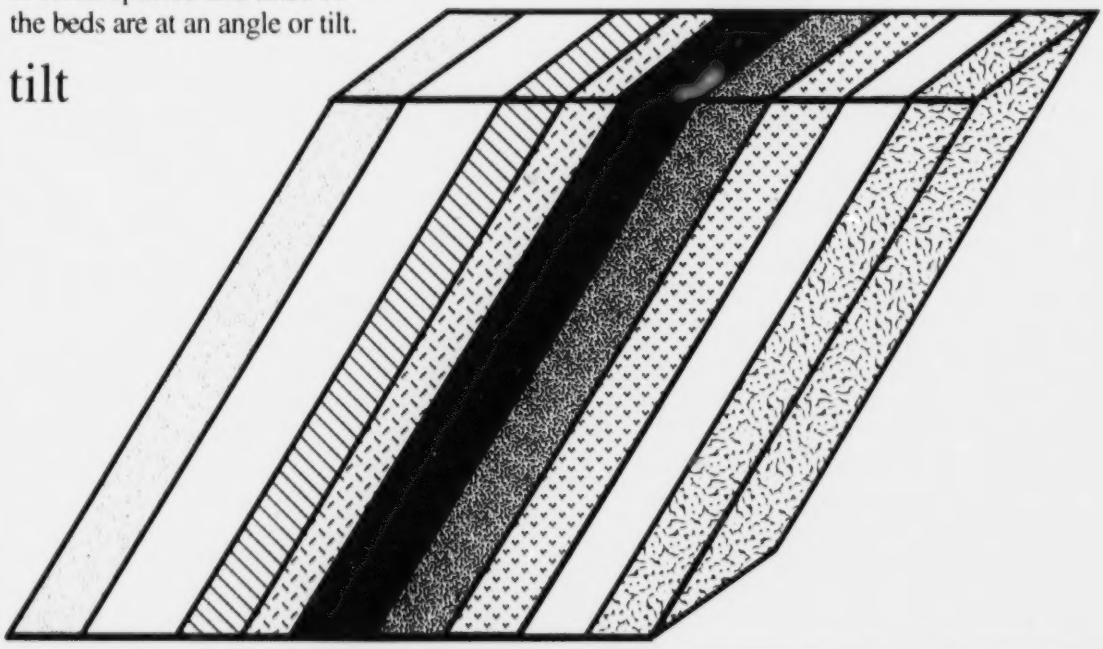
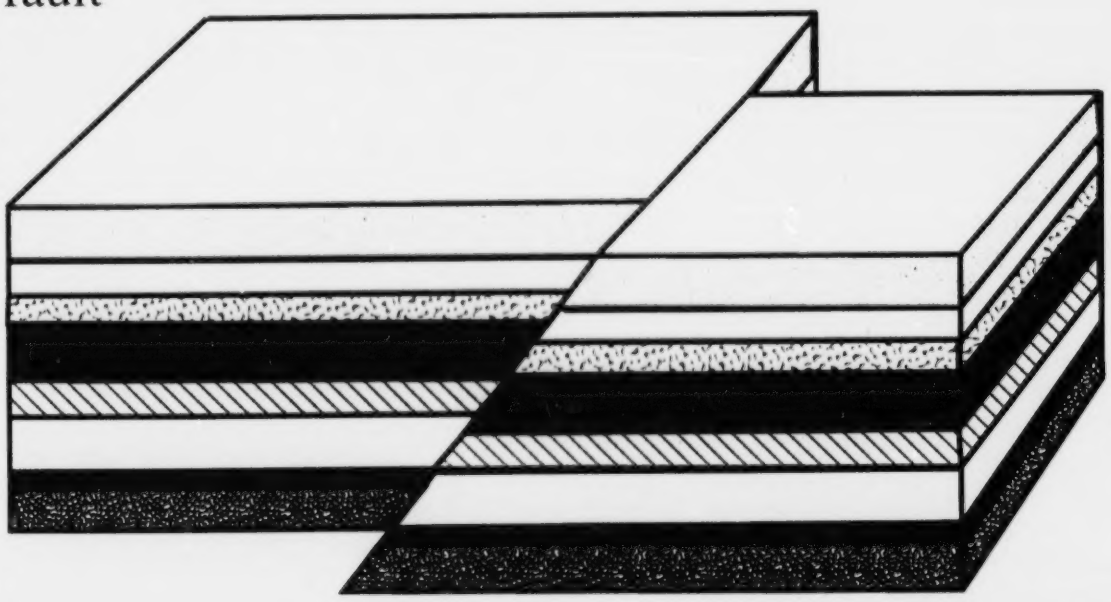


Figure 1 (con't.)

c. Rock shifted and broken so the beds have a fault.

fault



Instructions:

1. Divide the students into groups of four, with a container, water and portions of clay and sand available to each group. Make sure one group of students uses an aquarium or complete the activity in the aquarium as a demonstration.

2. Each group should fill their container about halfway with water.

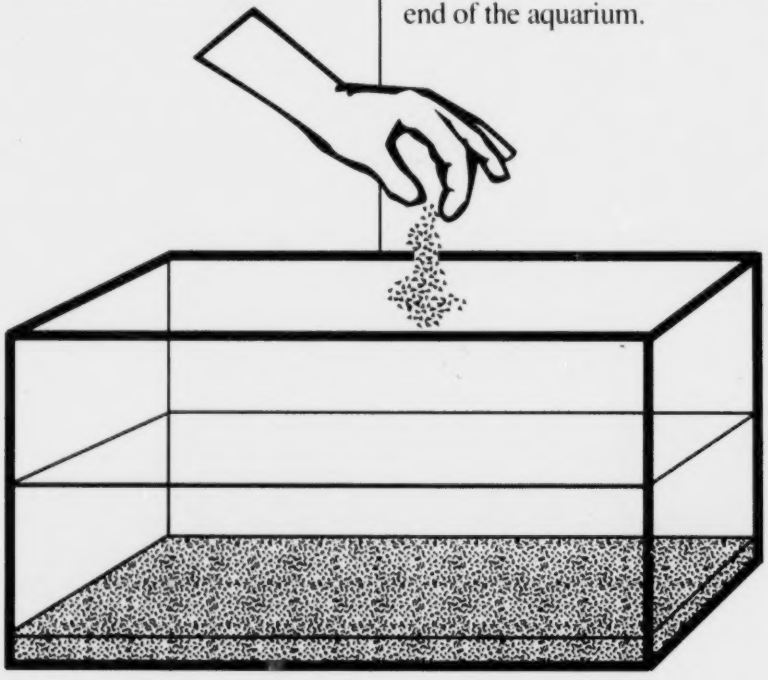
3. Have the students, very slowly, sprinkle some clay soil (or whatever material they are using) into the container of water to create a complete layer across the bottom.

4. Allow all of the deposited material to settle to the bottom of the container. (Timing will vary depending on the material used; generally it will take about one minute.)

5. After the first layer has settled, add a layer of sand (the second material). Then add one or two leaves to symbolize fossils embedded in the sedimentary rock. Continue making layers, alternating the clay and sand materials, until there are a minimum of eight layers. Remember to let the soil or sand settle for about a minute before adding the next layer.

6. After the final layer has settled, have the students observe the results in their container and make a sketch of the container with its different layers on the worksheet. The students should be sure to include the leaf "fossil" in their sketch.

7. Using the aquarium as a demonstration, take a stiff piece of cardboard or similar device and place it through the layers to the bottom at one end of the aquarium.



8. Ask the students to hypothesize what will happen to the horizontally layered sediments as you push the cardboard towards the other end. Have them write down their **hypothesis**.

9. Slowly move the cardboard, pushing and compressing the layers of sand and clay. By doing this you are changing the position of the layered soil that was deposited in the still water of the aquarium. This change in position of the sediments can be used to represent the rocks in the earth that are folded, faulted and changed by movement in the earth's crust. If you want, take your cardboard out and thrust it through the layers to show breaking and faulting. Have the students draw and write down the results of this compression and label the new geologic formations.

10. Discuss whether their hypotheses were supported or not, and why.

11. Be sure to discuss the following questions:

• How are sedimentary deposits, such as those which formed the rock found at Morrow Mountain State Park, formed naturally?

(They can be soils, rock fragments or the ash from volcanoes that are carried by wind or water and deposited in a layered fashion which produces results similar to those you can see in this activity.

Note: Sedimentary rock and often metamorphic rock which is produced from sedimentary rock shows this layering effect. The metamorphic rocks found at Morrow Mountain State Park started out as volcanic ash that formed layers at the bottom of inland seas.)

- Which layer is the oldest?
  (The bottom layer.)
- Which is the youngest?
  (The top layer.)
- Why are layers deposited in parallel layers?

(Due to gravity and the even distribution of sediments in still water.)

- Can the soil be layered on a slope?

(No.)

- Vertically?
  (No.)
- If the layers are tilted before they set up, what would happen?

(They would get jumbled and not show layers clearly.)

- What happens when they're tilted after they set up?

(They fold and fault. This should corroborate that the "uplift" and movement that occurred in the Uwharrie Mountains happened after the sedimentary rock was deposited.)

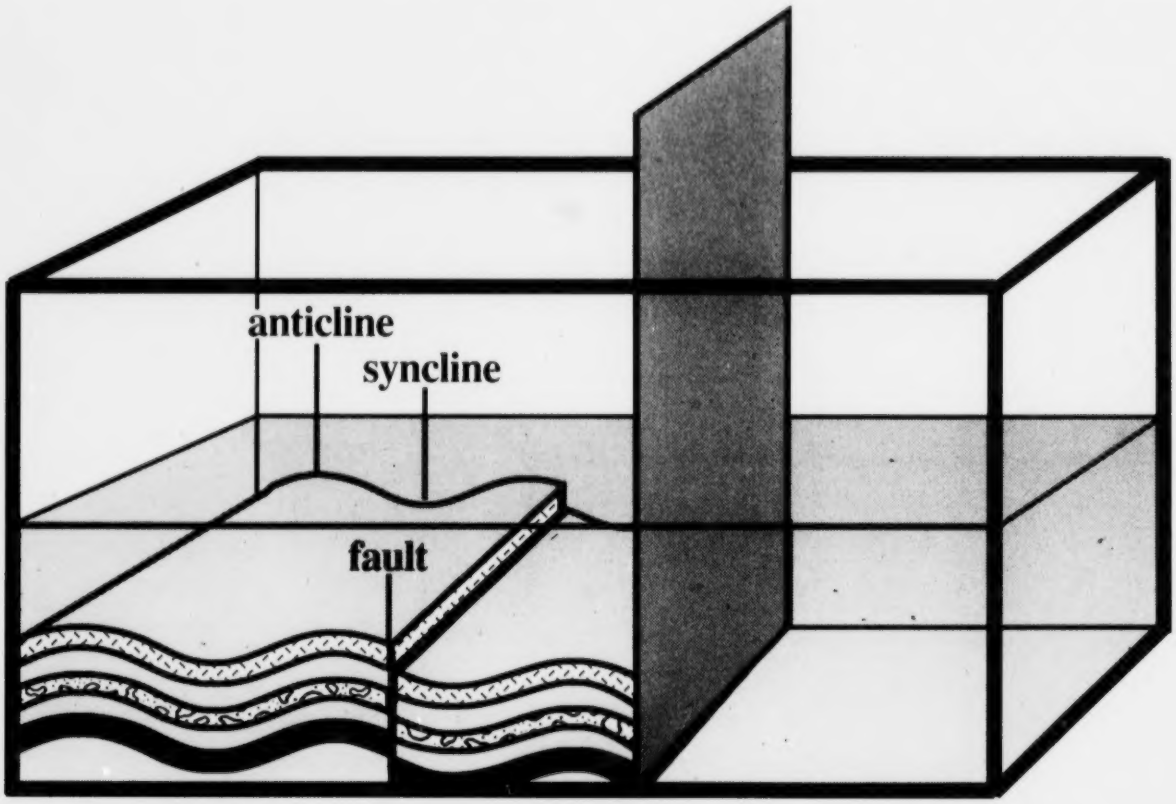
- What do the leaves represent?

(Fossils, that are rare in nature but have been found in the metamorphosed slate of this area.)

Suggested Extension:

1. The making of a multi-layer cake is also a way of showing layers. You could explain that the cake batter changes from its wet stage, by a process of time and heat, into solid layers.

2. The making of jello in layers can also be done to show layers. (Both the layered cake and "jellology" activities are available in the park's files)



Worksheet for Pre-Visit Activity #1 Layer on Layer

1. Draw the newly formed "sedimentary" rock, with fossil.

2. What will happen to the horizontally layered sediments when pressed from the side?

_____

_____

_____

3. What actually happened?

_____

_____

_____

4. Draw the compressed "sedimentary" rock. Label on your drawing the geologic formations created by this process.

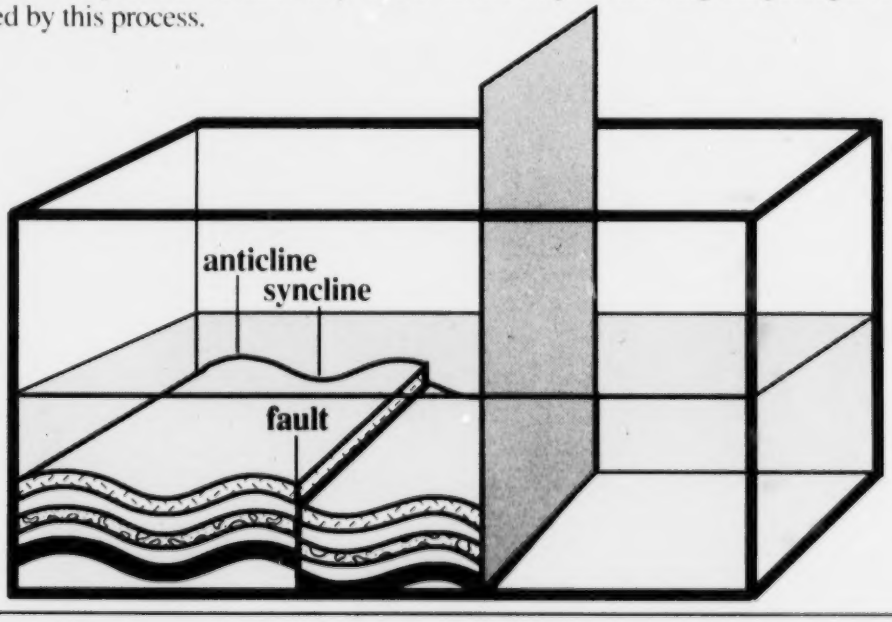
Answer Sheet for Pre-Visit Activity #1 Layer on Layer

1. Draw the newly formed "sedimentary" rock, with fossil.

2. What will happen to the horizontally layered sediments when pressed from the side? (**ANSWER**: They will be compressed together to form folds; the basin-like or bowl shaped ones are called synclines; the hill-like or humped ones ore called anticlines.).

3. What actually happened?

4. Draw the compressed "sedimentary" rock. Label on your drawing the geologic formations created by this process.



Pre-Visit Activity #2 — Cooking, Volcano Style

Curriculum Objectives:
Grade 5
- Communication Skills: listening, reading and viewing comprehension
- Guidance: group interaction
- Healthful Living: school safety
- Science: earth science, environment
- Mathematics: measurement
- Social Science: gather, organize, and analyze information, draw conclusions, cooperation

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: group interaction
- Healthful Living: recreational and home safety
- Mathematics: measurement
- Science: earth science
- Social Studies: gather, organize and analyze information, draw conclusions

Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: group cooperation
- Mathematics: measurement
- Social Studies: gather, organize and analyze information, draw conclusions

Location:
Classroom

Group Size:
30 students; one adult supervisor for every ten students is suggested, one adult per five students is preferred, especially for students in the lower grades

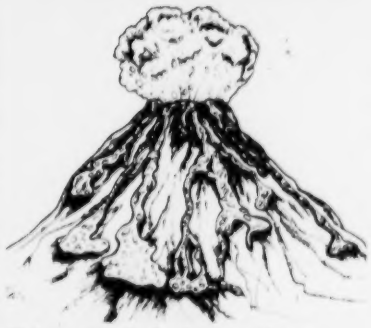
Estimated Time: 1 hour

Materials:
Provided by the educator:
One per group: hot plate, cookie sheet, candy thermometer, measuring cup, measuring spoons, spatula, 1 cup light corn syrup, 2 cups sugar, 1 cup water, 2 cups raw peanuts, 1/4 teaspoon baking soda, 1/4 teaspoon salt, 1 teaspoon butter or margarine plus enough extra to grease the cookie sheet, 1 heavy, medium-sized skillet

Special Considerations:
Caution should be used as the hot plate and peanut brittle will reach temperatures of over 290 degrees Fahrenheit.

Major Concepts:
- Igneous rock formation
- Lava
- Magma

Objectives:
- Name the two types of igneous rocks, explain how they are formed, and determine which type is found at Morrow Mountain State Park.
- Name the primary force in the formation of igneous rock.
- Define whether the process causing the formation of igneous rocks changes the rock structure, composition or both.



Educator's Information:

Through the making of peanut brittle, this activity shows how heating and cooling changes the structure of **rocks**. Just as the sugar starts off as a solid and is changed by heat into a liquid, **magma** is solid rock that has been melted below the earth's surface. When it reaches the earth's surface it is called **lava**. Peanut brittle compares to lava in many ways.

- They both flow very easily in their liquid state.
- Lava will flow over and around rocks just as the "brittle" will surround the peanuts in this activity. Rocks that are surrounded by lava but retain their integrity and are not melted are called **xenoliths**. In this activity the peanuts represent xenoliths.
- Both the "brittle" and lava change from a liquid to a solid state very quickly.
- The heating and melting of the "ingredients" of both peanut brittle and rocks causes changes in them, chemically and physically.

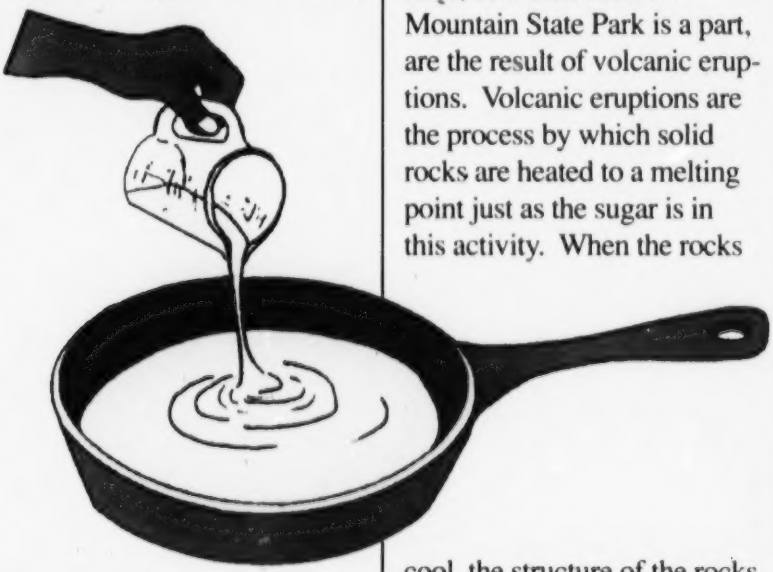
Instructions:

1. Read the following instructions to the students:

a. Blanch 2 cups unroasted peanuts (raw Spanish peanuts will not need blanching). To blanch, cover the peanuts with boiling water for 3 minutes; then run cold water over them. Remove coating.

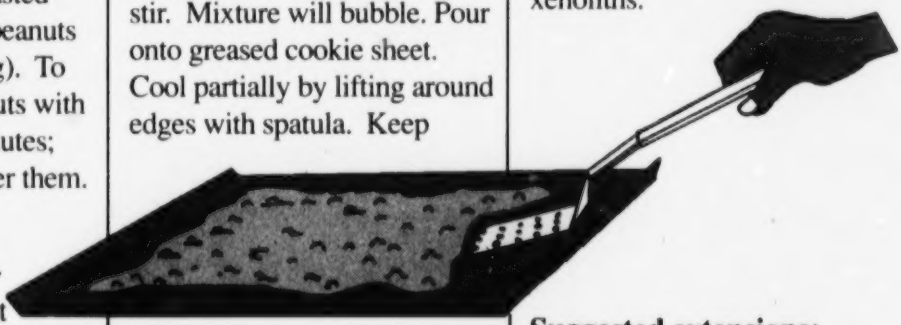
b. Grease cookie sheet.

c. Combine sugar, light corn syrup and water in a heavy skillet. Cook slowly, using the hot plate, stirring until the sugar dissolves. Check the temperature using the candy thermometer. Remove from heat while testing temperature. Cook to the soft-ball stage (238 degrees Fahrenheit).



d. Add nuts and salt to mixture and continue to heat, checking the temperature using the candy thermometer. Cook to hard-crack stage (290 degrees Fahrenheit), stirring constantly. Remove from heat.

e. Add butter and baking soda; stir. Mixture will bubble. Pour onto greased cookie sheet. Cool partially by lifting around edges with spatula. Keep spatula moving under mixture so it doesn't stick. When firm but still warm, turn over. Break into pieces when cool.



2. Be sure to discuss the following points: The rocks that formed the Uwharrie Mountains, of which Morrow Mountain State Park is a part, are the result of volcanic eruptions. Volcanic eruptions are the process by which solid rocks are heated to a melting point just as the sugar is in this activity. When the rocks cool, the structure of the rocks changes greatly just as the ingredients of this recipe are changed. Molten lava that flows from a volcano sometimes engulfs other rocks but leaves them intact. In this activity, the peanuts represent such rocks which are called xenoliths.

Suggested extensions:

1. Convert the recipe measurements to metric. (See conversion table.)

2. Make brownies. The batter will represent the earth in its molten state 4 1/2 billion years ago. The cooking represents the condensing and heating of the earth as it changed into a more solid sphere. The baked brownies, with their harder crust and softer interior would be the earth with its solid, igneous crust and softer mantle beneath. The bottom of the pan would be the earth's core which is believed to be made of heavy metals such as iron, nickel and lead. However, unlike the solid pan, which reaches a temperature of 290 degrees Fahrenheit, the earth's core is believed to be in a molten state with a temperature of 4,500 degrees Fahrenheit.

Student's Information:

Igneous rock has two forms: intrusive and extrusive. **Intrusive igneous rock** is melted rock, called magma, which never reaches the earth's surface but cools slowly within it. Granite is a good example of this type of igneous rock. Intrusive rock such as granite becomes exposed on the earth's surface due to **erosion** of the soil and rock above it.

Extrusive igneous rock is formed when magma (molten rock) spews out of a **volcano** onto the earth's surface. In this stage it is called lava. Lava on the earth's surface cools much faster than the intrusive form trapped beneath the surface. **Rhyolite** and **basalt** are two types of extrusive igneous rock found in Morrow Mountain State Park.

Igneous rock never contains fossils. Temperatures which are high enough to melt rock are also high enough to burn up any organic matter, plant or animal.

The igneous rock found at Morrow Mountain is the result of volcanic eruptions. Some of the sedimentary and metamorphic rocks which were part of the ocean floor were melted and became the lava spewed from the volcanoes. When the lava cooled, it had a totally different structure than the original rocks. This activity will be an edible simulation of that process, where the base "rock" is melted, and when cooled has a new form and structure.

Metric Conversion Table For Volume

Symbol	When You Know	Multiply By	To Find	Symbol
tsp	teaspoon	5	milliliter	ml
Tbsp	tablespoon	15	milliliter	ml
fl oz	fluid ounce	30	milliliter	ml
c	cup	0.24	liter	l
pt	pint	0.47	liter	l
qt	quart	0.95	liter	l
gal	gallon	3.8	liter	l

Pre-Visit Activity #3 Hard Rock Crayola

Curriculum Objectives:
Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: group cooperation
- Healthful Living: recreational and school safety
- Science: earth science, environment
- Mathematics: measurement
- Social Science: organize and analyze information, draw conclusions, participation

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills
- Guidance: group cooperation
- Healthful Living: recreational and home safety
- Mathematics: measurement
- Science: earth science
- Social Studies: gather, organize and analyze information, draw conclusions

Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills
- Guidance: group cooperation
- Mathematics: measurement
- Social Studies: gather, organize and analyze information, draw conclusions

Location:
Classroom/science lab

Group Size:
30 students or less, divided into six groups

Estimated Time:
Two to four hours

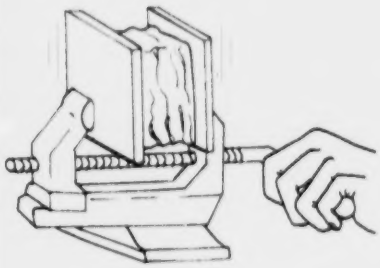
Credits:
This activity has been adapted from "Color Me Metamorphic" by Donald L. Birdd, *The Science Teacher*, April 1990, pp. 21-26.

Materials:
Provided by the educator:
Per group: hot plate, oven mittens, petri dish or finger bowl, aluminum foil (45cm x 45cm), three aluminum foil pie trays, wax paper, a metal or wooden trivet, newspapers
Per student: "Rock Cycle" and "Hard Rock Crayola" worksheets, safety goggles, pencil sharpener or carrot peeler, candles or four to six crayons of the same color (red, green, blue, or yellow), envelope
Per class: one or more vises with two boards (12.5 cm x 20 cm), rock samples

Special Considerations:
Take proper safety precautions. The hot plate and hot crayon wax can cause burns. The vise can pinch/crush fingers.

Major Concepts:
- Rock cycle
- Mechanical weathering
- Sedimentary rock formation
- Metamorphic rock formation
- Igneous rock formation

Objectives:
- List the three main rock types.
- Describe how these three rock types are formed.
- Explain the rock cycle.
- Describe four processes by which one rock type changes into another.
- Name a metamorphic and an igneous rock found in the park.



Educator's Information:

Many students have a difficult time understanding the abstract concept of the **rock cycle**, the process by which **sedimentary, metamorphic**, and **igneous rocks** are transformed into and from one another. The students can see **rock** examples in the classroom; the difficulty lies in their inability to visualize just how these rock samples were formed. The following activity will give the students the opportunity to "see" the rock cycle through a series of simulations of mechanical **weathering, erosion**, and formation of sedimentary, metamorphic and igneous rock. The activity can be done as one continuous process or can be broken down into five separate parts.

Student's Information:

There are three basic **rock** classifications:

1) **Sedimentary rock** - rock that is composed of particles of sand, clay, or other rocks that were deposited in layers on land or on the bottom of lakes, rivers or oceans. Over time, the extreme pressure from the weight of the layers above pressed the materials into rock. Examples are limestone, sandstone and **shale**.

2) **Igneous rock** - rock which is solidified from a molten state. Igneous rocks form deep within the earth in **magma** chambers embedded in solid rock. They may be **intrusive** or **extrusive** in nature. Magma which cools and stays within the earth is intrusive. Magma which is spewed out by **volcanoes**, **lava**, is extrusive. Examples of **extrusive igneous rocks** found in the park are **rhyolite** and **basalt**.

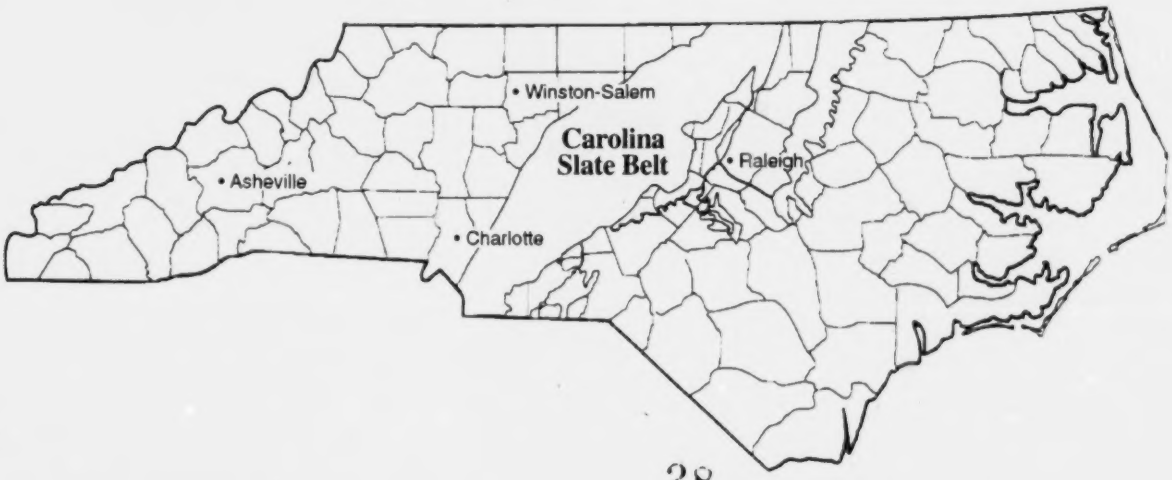
3) **Metamorphic rock** - sedimentary or igneous rock that is changed deep inside the earth by extreme heat and pressure over a long period of time into a harder rock, with different qualities. Examples of sedimentary rock changing to metamorphic rock are marble, which is made from limestone; and **slate**, which is made from shale.

Metamorphosis means a transformation, a marked change in appearance or condition. An example with which you will be familiar is that of a caterpillar changing, or metamorphosing, into a butterfly. The metamorphic rock found at Morrow Mountain State Park is slate. Slate is formed from shale, a sedimentary rock. Shale is formed from volcanic ash, or **sediment**, which falls into water and settles to the bottom. It is a rock with distinct layers and is relatively soft. Over time, pressure from the water above and the upper layers of ash cause the bottom layers to change, or metamorphose, into slate.

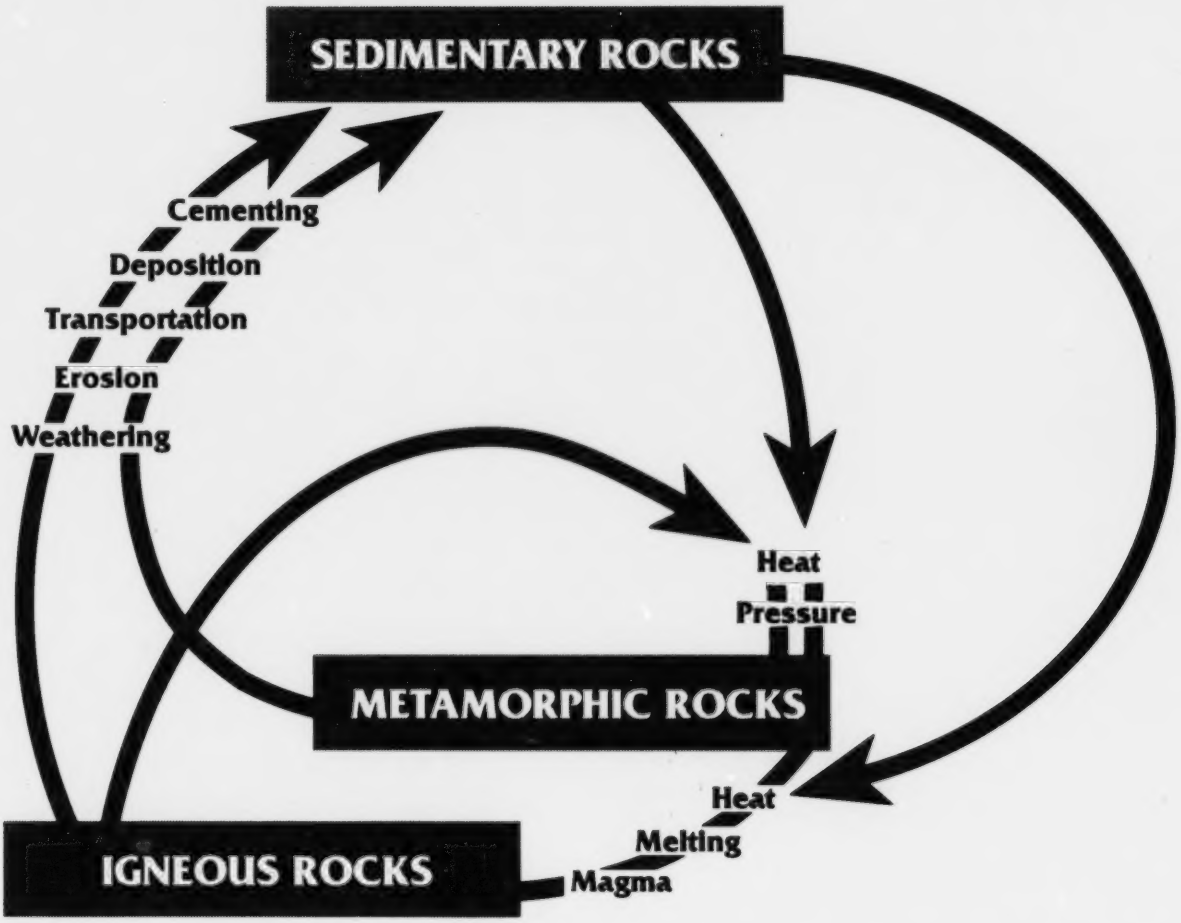
Slate, a very common rock at Morrow Mountain State Park, is easily seen along many of the stream beds. Many of the buildings are constructed from slate that came from a quarry within the park.

Slate underlies a large section of the Piedmont region of the southeastern United States. It is found in such an expansive area that geologists have named a large portion of the Piedmont the Carolina Slate Belt. This slate belt extends from northeastern Virginia to southwestern Georgia.

Rock in the Carolina Slate Belt has been extensively compressed and tilted due to various mountain-building episodes. Although the layers were originally horizontal, many of these rocks are in a near vertical position now. When mountains are pushed up, metamorphic rocks are often formed, and different types of rocks become pushed and jumbled together.



Rock Cycle


SEDIMENTARY ROCKS
Cementing
Deposition
Transportation
Erosion
Weathering
Heat
Pressure
METAMORPHIC ROCKS
Heat
Melting
Magma
IGNEOUS ROCKS

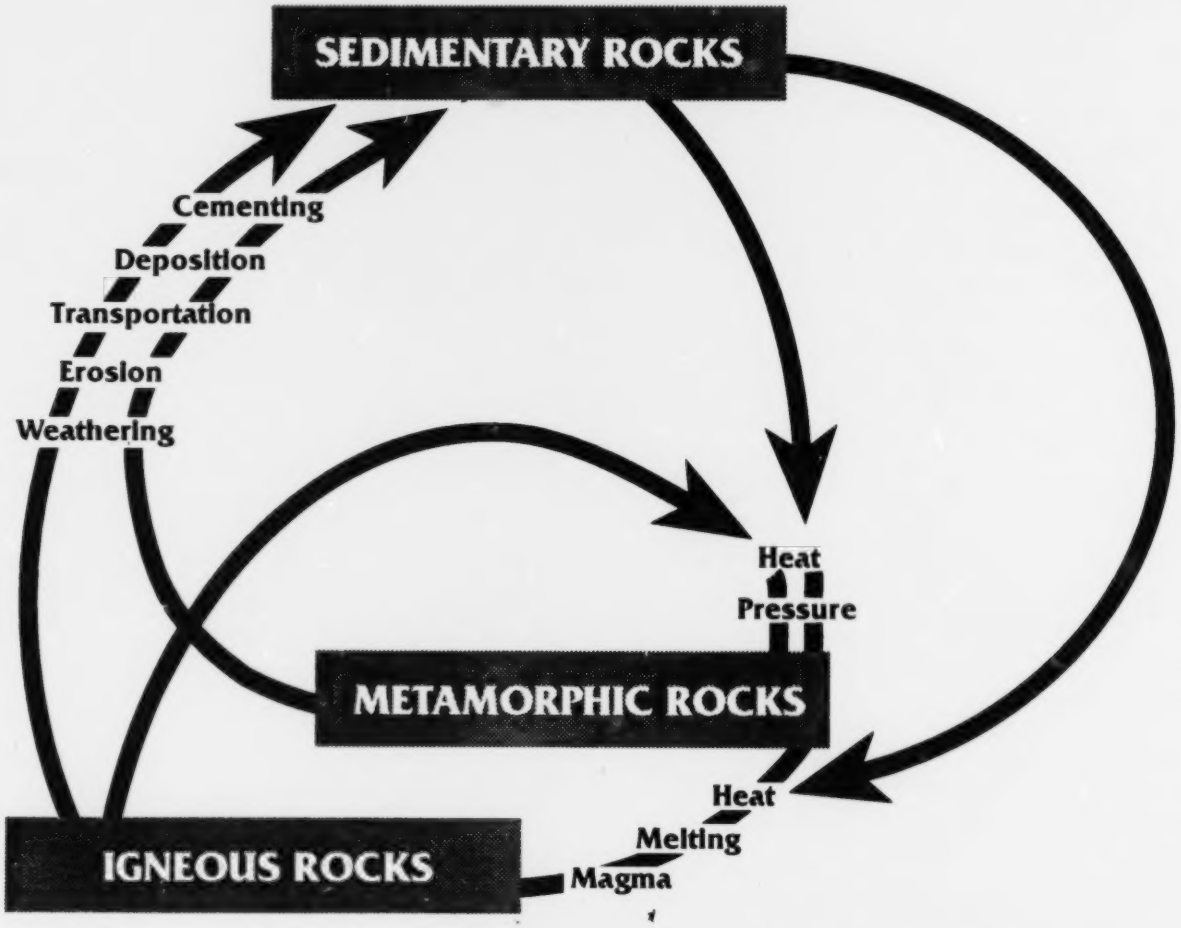
Instructions:

Ask the students to describe local rocks and/or rock formations. They have seen rocks during walks along a lakeshore or river's edge, near or on a mountain, or during a drive along a highway that was built through road cuts. On the chalkboard, write down all the names and characteristics the students can remember about the rocks. Be sure to have several local rock samples distributed around the room.

Ask the students questions such as, "Have you ever wondered just how these rocks formed?" "Are new rocks forming at this moment?" Be sure to go over the Rock Cycle diagram. Discuss the three kinds of rock with the students.

Part A:
Weathering

Cover all desk tops with newspaper. Give each student a sheet of wax paper, a pocket pencil sharpener or carrot peeler, and a candle or four to six crayons of the same color. The candles/crayons represent rock material, and the carrot peelers/pencil sharpeners represent weathering agents. Students should carefully shave each of the candles/crayons keeping all of the fragments in a small pile. As they are "weathering" their candles/crayons onto the wax paper, call their attention to the size and shape of the fragments. "Are they all the same size and shape? Why or why not?" [Not the same size and shape due to varied weathering forces upon them (i.e. how the sharpener or crayon are held) etc.] "What are some of nature's weathering forces?" (Rain, flowing and freezing water, glaciers and wind.) When the "weathering" is complete, the students should wrap their "sediments" in their wax paper and place each color in a separate envelope, unless you plan to do Part B of this activity right away.



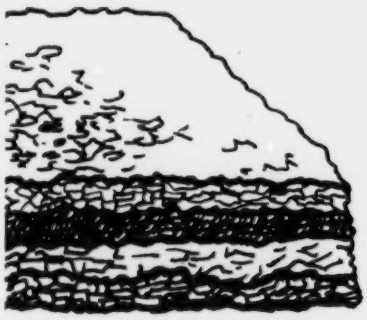
Part B: Erosion and Sedimentation

Once rock fragments have been created, they are usually moved by some force of nature. Here, the students act as the erosive force. Ask the students what this force of movement is called, and what some of its causes are. (Erosion, caused by gravity, moving water, glaciers and wind.) Place all the weathered "rock" fragments in four separate piles, one color to a pile. Divide the class into four (or eight) groups, and give each group a sheet of aluminum foil (45 cm x 45 cm). Next, a student from each group should carefully transfer some "weathered sediments", of one color, to the center of the foil. Spread them into a 1 cm thick layer. Repeat with the remaining colors, layering the colors one on top of another.

Students should record their observations of their layered "weathered sediments" on the "Hard Rock Crayola" worksheet. Fold the foil over the "sediments" layers, allowing for a 1 cm space all around the fragments, and then carefully fold the edges to seal the packages. If you are breaking the activity into sections, have the students each label their foil packages by their group numbers and stop here.

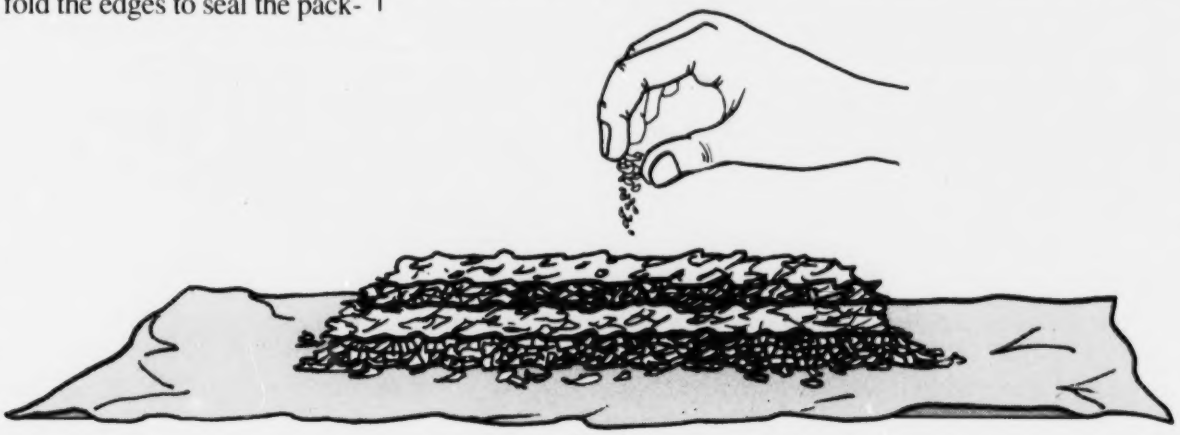
Part C: Sediments/Sedimentary Rock Simulation

Unless you have more than one vise, this step will take some time and will require some patience. Each group will place their folded foil package between two boards. The "sandwich" should then be placed in the vise. Apply light pressure with the vise to compress the "sediments". Once the "rock sandwiches" have been mildly compressed, remove them from the vise. Students should then carefully open their packages and observe the new product. Call their attention to the central region which is more tightly compressed. The students should lift this portion from the non-compressed or more loosely packed "sediments" and carefully break it into two parts. Have the students look at the broken edges, then draw and describe the layers (on the worksheet). How do they compare with the original loose "sediments" layers? (They're similar but much thinner.)



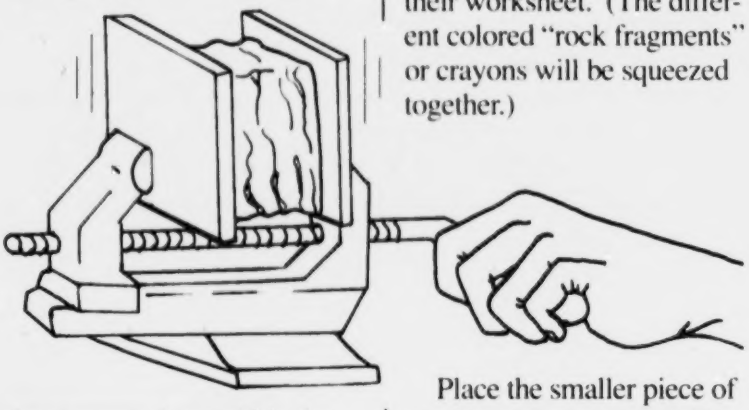
What happened to the spaces between the "sediments"? (Pressure from the vise forced the "sediments" closer together eliminating the spaces.)

Each group should transfer a few of their loose "sediments" and the smaller piece of "sedimentary rock" into a pie pan. Place the rest of the fragments in an envelope, (for part E). The pieces in the pie pan will be used for comparisons with the other "rocks" the students will produce during this activity. Return the larger piece of "sedimentary rock" to the aluminum foil and wrap it up again. If you are breaking the activity into sections, stop here.



Part D: Metamorphic Rock Simulation

Place the foil package with the "sedimentary rock" in it between the two boards and put it into the vise again. Tell the students to add as much pressure to the vise as they can. This part of the activity demonstrates the need for great pressure to cause a rock to metamorphose. In reality, as



the pressure deep within the earth increases, temperatures increase as well. A temperature change is probably occurring in this activity but is difficult to measure. (The heat associated with the formation of metamorphic rock is not a part of this activity.) Remind the students that metamorphic rock may become contorted in appearance. It may actually flow like a plastic material in response to the pressure from the rock load above and crustal plate movement.

Have the students release the compression on the vise, remove the foil package and open it carefully to examine the newly formed "metamorphic rock". They should carefully break this "rock" into two parts and examine it,

noting what happened to the thickness and fragment shape. The students should write down their observations on their worksheet. (The different colored "rock fragments" or crayons will be squeezed together.)

Place the smaller piece of newly-made "metamorphic rock" with the "weathered sediments" and the "sedimentary rock" previously saved. If you are breaking the activity into sections, stop here.

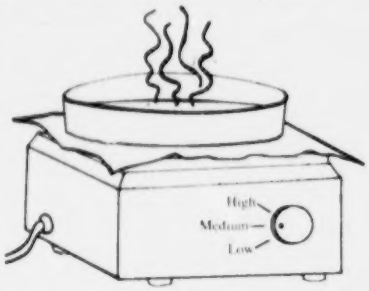
Part E: Igneous Rock Formation

SAFETY NOTE: This portion of the activity requires that the students be especially safety conscious as they will be working with a hot plate and melted wax.

Each group should line their last two trays with aluminum foil. Each group should fill one tray halfway with the following:

- Groups 1 and 2 fill their tray halfway with crushed ice;
- Group 3 fill their tray half way with warm water;
- Group 4 leave their tray empty, except for an aluminum foil lining, and place it on a trivet.

For the "igneous rock" simulation, the groups should place the fragments they set aside in envelopes, and the larger piece of "metamorphic rock", into their second aluminum tray. **Be Especially Careful Here!** This part of the activity requires a hot plate as a heat source. **Students Should Avoid Dropping Wax Fragments on the Hot Plate Surface or Themselves.** The students or teachers doing this portion of the activity should wear protective oven mittens to avoid being burned. Cover each hot plate surface with a layer of foil before you turn it on. (This will diffuse the heat from the coils of the hot plate so the crayons will not burst into flames.) Each group should place their tray of "weathered sediments" and "metamorphic rock" on the hot plate and turn the hot plate



temperature to medium. Melt the wax, being careful that the melting process does not occur

so rapidly that the molten wax splatters or burns. When most of the "rock" and "sediments" are molten, turn the hot plate off and carefully remove the tray, using the oven mittens. There is enough heat energy in the molten wax to melt the remaining solid mass. **Caution: Do not let the wax heat to the splattering point!**

While the wax is still in the molten state, a student from each group, or the teacher, should CAREFULLY do the following:

Group 1 - Form a trench in the ice. Using the oven mittens pour the melted wax (magma) into the crack (rock fissure). Carefully cover the wax with more crushed ice. (This will simulate the formation of an intrusive igneous rock.)

Group 2 - Using the oven mittens, pour the melted wax (lava) directly over the surface of the crushed ice. (This will simulate the formation of extrusive igneous rock in a cold region.)

Group 3 - Using the oven mittens, pour the melted wax into the warm water. (This will simulate the formation of extrusive igneous rock in a warm region.)

Group 4 - Using the oven mittens, place the tray of melted wax into the tray on the trivet. Do not pour out the molten contents. Leave them in the original tray. (This will act as the control in this experiment and simulate the formation of extrusive igneous rock in a temperate zone.)

Students should make observations of all the groups' trays, and draw and write these down on their worksheet. Encourage groups to compare their results. For instance, comparisons should be made between the crystal sizes formed by Groups 1 and 4. Comparisons should also be made between these

"igneous rocks" and the "rocks" and "sediments" made in the previous sections of this activity.

Set aside all "igneous rock" trays until the next day's class; the materials must sit overnight. This will allow the wax to cool. The next day, have the students carefully remove the "igneous rock" from the water or tray. Be sure to look at the lower surface of the "rock". Compare the formations of each groups' experiment.

As a class be sure to discuss the following:

With the tray of Group l, discuss the effect the "magma" had on the "sedimentary or metamorphic rock" it came in contact with.

With the tray of Group 2, discuss the effect the "lava" had on the "surface sediments, rocks and ice" in a cold region.

With the tray of Group 3, discuss the effect the "lava" had on the "sediments, rocks and water" of a warm region.

With the tray of Group 4, discuss the effect of "lava" flowing directly onto the land in a temperate zone, such as Mt. St. Helens in Washington.

Remind the students of the igneous rocks common to this area and the park, such as rhyolite and basalt. Also mention that all conditions for rock formations cannot be simulated. In fact, geologists have never seen intrusive rocks form. However, they are able to look at all of the available evidence, simulate some of the conditions in the laboratory, and arrive at results similar to those found in nature.

Reiterate the concept of the rock cycle by reminding them of the "rocks" (crayons or candles) that were weathered down into "sediments", compressed into "sedimentary" and then "metamorphic rock" and then melted into "igneous rocks".

Worksheet for Pre-Visit Activity #3 Hard Rock Crayola

1. Describe and draw the "weathered sediments" that you made. Note the sizes and shapes of the "sediments".

2. Draw a color picture of the "rock fragments" after light pressure has compacted these "sediments" into "sedimentary rock". Describe the broken edge and the layers that are formed.

3. Draw a color picture of the "sedimentary rock" after heavy pressure has compacted it into "metamorphic rock". Describe the broken edge and the layers that are formed. Note how they have changed with the addition of heavy pressure.

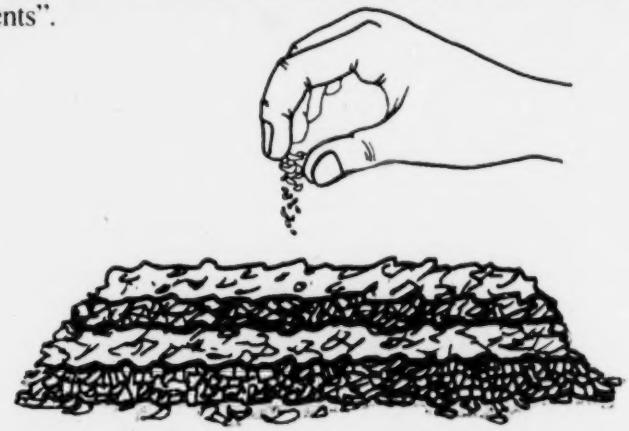
4. Draw each of the melted wax formations created in the four different experiments of Part E. Compare and contrast the experimental results.

Group One's "Igneous Rock"	Group Two's "Igneous Rock"
Group Three's "Igneous Rock"	Group Four's "Igneous Rock"

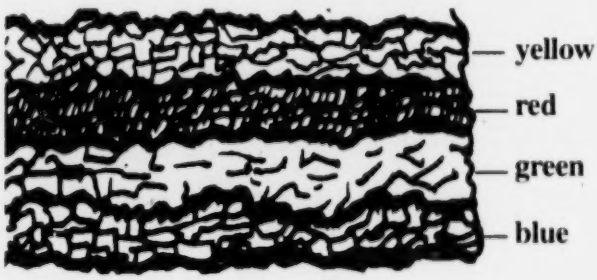
5. Write a comparison between the "weathered rock fragments", "sedimentary rocks", "metamorphic rocks" and "igneous rocks" formed in this activity. Compare and contrast them as to color, crystal size, texture, form and formation.

Answer Sheet for Pre-Visit Activity #3 Hard Rock Crayola

1. Describe and draw the "weathered sediments" that you made. Note the sizes and shapes of the "sediments".



2. Draw a color picture of the "rock fragments" after light pressure has compacted these "sediments" into "sedimentary rock". Describe the broken edge and the layers that are formed.



3. Draw a color picture of the "sedimentary rock" after heavy pressure has compacted it into "metamorphic rock". Describe the broken edge and the layers that are formed. Note how they have changed with the addition of heavy pressure.

4. Draw each of the melted wax formations created in the four different experiments of Part E. Compare and contrast the experimental results.

Group One's "Igneous Rock"	Group Two's "Igneous Rock"
Group Three's "Igneous Rock"	Group Four's "Igneous Rock"

5. Write a comparison between the "weathered rock fragments", "sedimentary rocks", "metamorphic rocks" and "igneous rocks" formed in this activity. Compare and contrast them as to color, texture, form and formation.

The "weathered rock fragments" will vary in size and shape depending on the implement used: pencil sharpener, potato peeler, etc. The "sedimentary rocks" will be bound together very loosely and individual "rock fragments" can be oriented (up/down or right/left) in any direction. In "metamorphic rocks" the space between fragments is very small and the orientation of "fragments" is now flattened (right/left). The thickness is much thinner, but each layer of rock (color) can still be seen. The "igneous rock" is grayish-black (melting and mixing of different "rock fragments") with a variety of forms depending on how the separate groups are cooled. Where the "igneous rock" is poured over ice it tends to fill the spaces between the crushed ice and is very rough to the touch. In cool water it forms short "stalagtites", while in hot water the "stalagtites", are longer. If the "igneous rock" is left in its pan, it is smooth on both sides. **(The different methods of cooling are not intended to simulate real rock formations; they do, however, give the students the understanding that different cooling conditions will create different rocks.)**

Pre-Visit Activity #4 — Cracking Up

Curriculum Objectives:

Grade 5
- Communication Skills: listening, reading and viewing comprehension, writing
- Guidance: group cooperation
- Science: earth science, environment
- Mathematics: measurement, probability
- Social Science: organize and analyze information, draw conclusions, participate effectively in groups

Grade 6
- Communication Skills: listening, reading and viewing comprehension, study skills, writing
- Guidance: group cooperation
- Mathematics: measurement, probability
- Science: earth science, environment
- Social Studies: gather, organize and analyze information, draw conclusions

Grade 7
- Communication Skills: listening, reading and viewing comprehension, study skills
- Guidance: being responsible in a group
- Mathematics: measurement, probability
- Science: soils
- Social Studies: gather, organize and analyze information, draw conclusions

Location:
Classroom; students may do this activity at home if a freezer is not available at school.

Group Size: Any size

Estimated Time: Overnight

Credits:
This activity was adapted with permission from the National Wildlife Federation's Naturescope: Geology, The Active Earth.

Materials:
Provided by the educator:
Per group: one clean, empty, plastic or cardboard pint milk carton (bottom half only), one ruler, waterproof marking pen, one small balloon, plaster of Paris, two ice cube trays, two paper towels, water, a mixing container, sand, several flat pieces of slate (borrowed from the park)
Per student: "Cracking Up" worksheet, pencil

Special Considerations:
Do not use any type of glass container.

Educator's Information:

This activity has two parts. The first part simulates the process whereby water, through freeze-thaw activity, cracks and then breaks rocks apart. The second part simulates how water and ice abrade and erode rocks over which they travel.

Major Concepts:
- Weathering
- Environmental changes
- Erosion
- Hypothesis testing

Objectives:
- Write and test hypotheses on what happens to water when it freezes.
- State what happens to water when it freezes and how the freezing of water can shape the land.
- Explain how sediments suspended in water or ice shape the land.

Student's Information:

You might be surprised to discover that temperature variations can cause **rocks** to break as surely as someone hitting them with a hammer. Water is a major factor in the **weathering** and **erosion** of rocks. The strength of water, especially freezing water, can be a very powerful force. Freezing water is probably more responsible for the crumbling and splitting of rocks than any other factor.

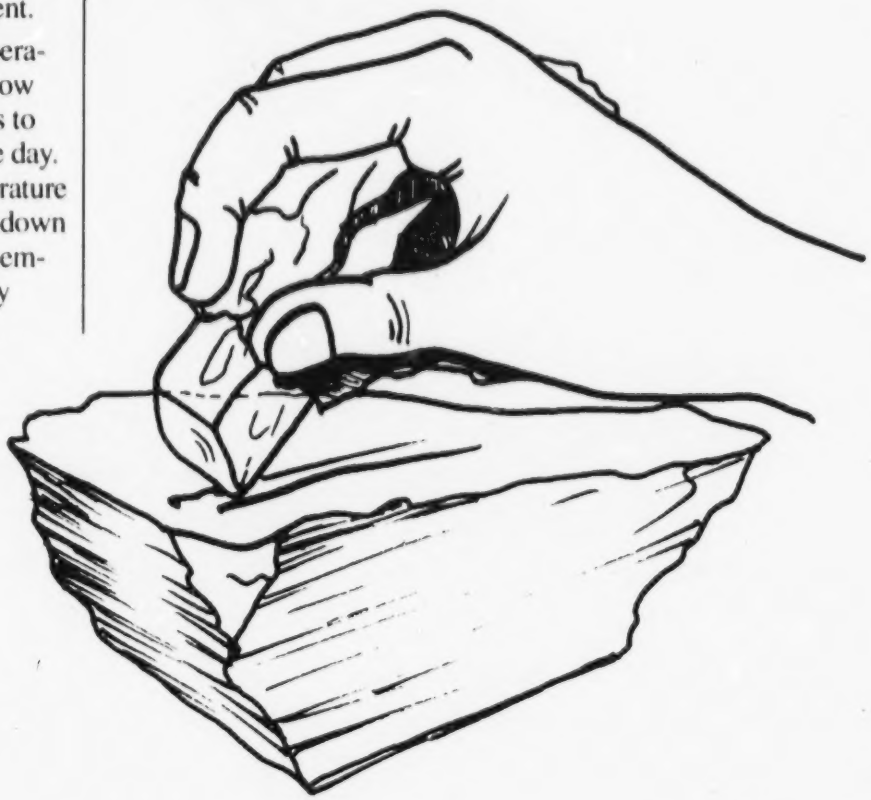
Water, upon freezing, expands its volume by 9%. When water seeps into cracks in a rock and freezes, the expansion widens the cracks. Eventually this process, known as ice wedging, breaks the rock apart. Ice wedging is a very important weathering agent.

In the winter, the temperature sometimes drops below freezing at night and rises to above freezing during the day. This fluctuation in temperature will cause rocks to break down more quickly than if the temperature were consistently above or below freezing.

Glacial movement can have significant effects on rocks as the ice flows move across the land, picking up and re-depositing rock materials. As the rocks trapped on the bottom of the glacier scratch and gouge the earth's surface, they are also worn down by this grinding action.

During the last ice age, this type of glacial activity may have occurred in the upper ends of north-facing valleys in the Appalachian mountains. However, there is no indication that glaciers ever existed in the Uwharrie Mountains.

In the last century, winters in North Carolina were colder than they are today. The Yadkin and Uwharrie rivers, and many others, froze over so thick that local farmers could cut ice blocks from the river and store them in ice houses for summer. The thick ice on the rivers helped break down rocks in and along their banks. As the ice expanded in the winter and broke apart in the spring, it would grind rocks together in the same way glaciers did tens of thousands of years ago.



Instructions:
Day 1 - Part A

1. Divide the students into groups of four and have each group label a milk carton with their group name and two ice cube trays.

2. Have each group of students take a balloon and fill it with water until it is about the size of a ping-pong ball. Tie a knot in the end of the balloon.

3. Have each group mix water with plaster of Paris until the mixture is about as thick as yogurt and pour the mixture into a milk carton. Have one student push the water balloon into the plaster in the carton until it is about 1/4 inch under the surface of the plaster. He or she should hold the balloon down until the plaster sets enough so that the balloon doesn't rise to the surface.

4. Have the students write their hypotheses on what they think will happen to the balloon and the plaster of Paris when they are frozen. Set the milk carton aside until later.

Part B

5. Have each group fill one ice cube tray with clean water. Then have them mix several teaspoons of sand with water and fill the second tray with the sandy water.

6. Have the students write hypotheses on what they think will happen when they rub the "clean" ice cubes and the sandy ice cubes against the slate.

7. Have each group place their milk carton and ice cube trays in the freezer overnight. Note: The plaster should harden at least one hour prior to going in the freezer.

Day 2 - Part A

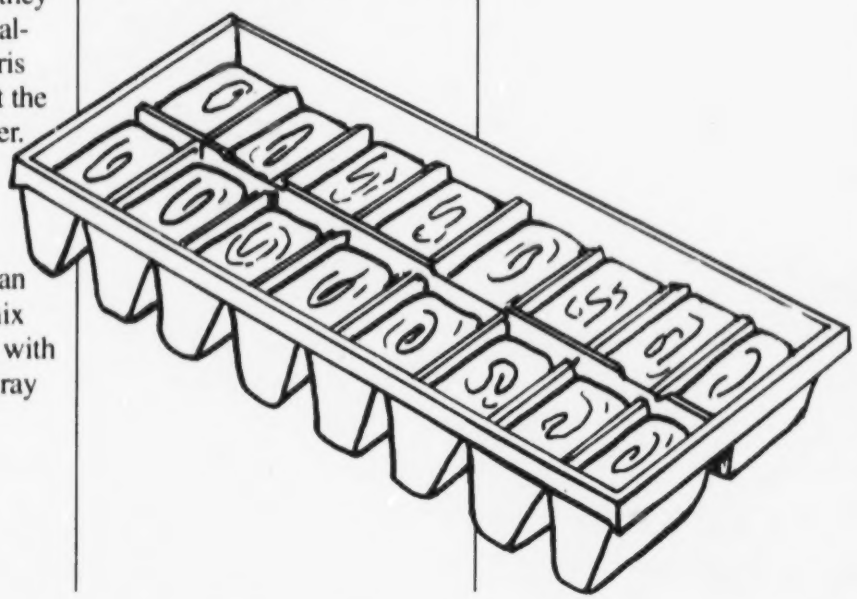
8. The next day, have the students remove the milk carton from the freezer and observe what happened. Have them write down their observations and compare them to their hypotheses. (The plaster was cracked as the water in the balloon froze and expanded.)

9. Have the students speculate what would have happened if the milk carton had been sealed. (The top and/or sides would have burst or swelled outward. This is what happens when water freezes where it has no room to expand, such as in cracks in rocks or in unprotected water pipes in winter. Then, when it freezes, it breaks the rocks apart or bursts the pipes. This process can easily be seen in the park on Tater Top and Mill Mountains.)

Part B

10. Have the students remove the ice cube trays from the freezer.

11. Using a paper towel, have the students pick up the "clean" ice cubes. Holding the "clean" ice tightly against a piece of slate have them slowly rub the ice cube across the rock several times.



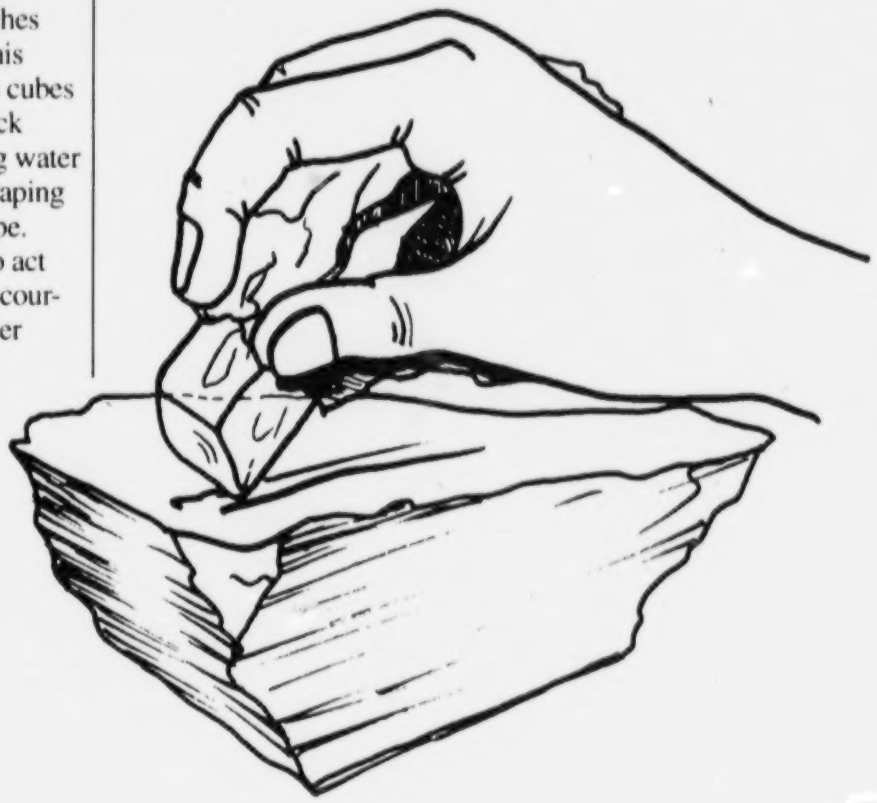
12. Have them do the same with the sandy ice cube on another piece of slate (or a different portion of the rock).

13. Have the students examine the surface of the rocks and write down their observations. (The ice cube with the sand acted like sandpaper. It should have left scratches on the rock's surface. This means that the sandy ice cubes acted like particles of rock suspended in the flowing water of streams and rivers scraping and shaping the landscape. The sandy ice cubes also act like miniature glaciers, scouring the land's surface over which they pass.

The clean ice cube left only a wet smear but no scratches. If streams and rivers were only pure water with no suspended sediments, they would not scour the earth's surface as much as they actually do. The cleaner the flowing water or ice, the less the scouring action that occurs.)

Suggested Extension:

Consider adding another milk carton to the activity. This second milk carton would contain only plaster of Paris. It would act as a control in this experiment. The plaster in this carton should not crack when frozen.



Day 1 Worksheet for Pre-Visit Activity #4 Cracking Up

Part A

1. With the milk carton, write a hypothesis on what you think will happen to the balloon and the plaster of Paris when the water is frozen.

Part B

1. Write a hypothesis on what you think will happen when you rub the "clean" ice cubes and the sandy ice cubes against the slate.

Day 2 Worksheet for Pre-Visit Activity #4 Cracking Up

Part A

1. Remove the milk carton from the freezer and observe what happened to the balloon and plaster of Paris. Write down your observations and compare them to your hypothesis.

2. Speculate what would have happened if the milk carton had been sealed.

Part B

3. Remove the ice cubes from the freezer. Rub the "clean" and sandy ice cubes on the rocks, then examine where the rocks were rubbed. Write down your observations.

On-Site Activity #1 — Rock ID

Curriculum Objectives:
Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills
- Guidance: group interaction
- Healthful Living: recreational safety
- Science: earth science, environment
- Social Science: organize and analyze information, draw conclusions, participate effectively in groups

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills
- Guidance: group interaction
- Healthful Living: recreational safety
- Science: earth science, environment
- Social Studies: gather, organize and analyze information, draw conclusions

Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills
- Guidance: group cooperation, develop an awareness of alternative points of view
- Science: earth science, earth forms, natural phenomena
- Social Studies: gather, organize and analyze information, draw conclusions

NOTE: Before arriving at the park for the on-site activities, teachers and students should read the Appendix, Summary of the Uwharrie Mountains Geology.

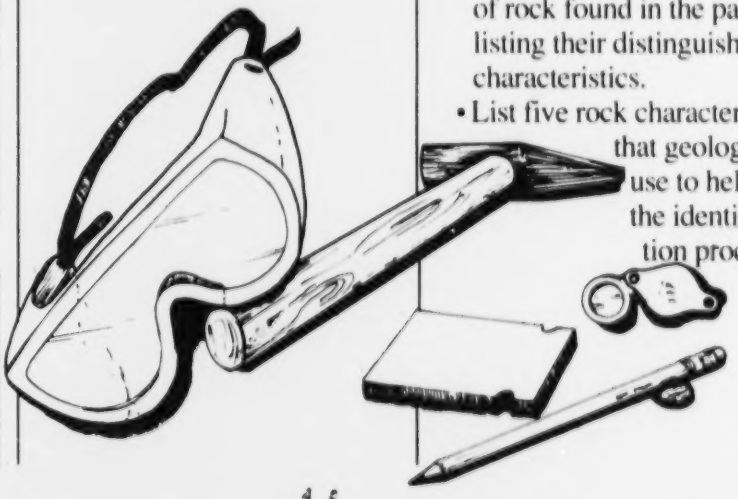
Location: Lower picnic area

Group Size:
30 or less, seven groups of about four students each

Estimated Time: 50 minutes

Materials:
Provided by the park:
large rock identification worksheet for the instructor
Per group: index card, hammer, safety goggles, streak plate, penny, steel file, hand lens, "Rock and Mineral" fact sheet, rock set (slate, weathered slate, basalt, rhyolite and quartz)
Provided by the educator:
Per student: "Rock ID" worksheet, pencil

Special considerations:
During part of this activity, students will break rocks apart to determine the rock's color. Rock fragments can be very sharp and may fly off and hit the student breaking the rocks or other students. It is important for all students to wear safety goggles during this activity.



Educator's Information:

In this activity the students will identify five different types of **rock**. Each one is found at Morrow Mountain State Park and some can probably be found around the students' home and school.

The students will complete the "Rock Identification" worksheet. For each of the five rock samples, they will determine color, streak color, **luster**, hardness, whether it is layered or not, its name and classification.

Major Concepts:
- Rock formation
- Rock characteristics
- Sedimentary, metamorphic and igneous rocks

Objectives:
- Identify the major rock types found at Morrow Mountain State Park and determine their origin.
- Identify three different types of rock found in the park by listing their distinguishing characteristics.
- List five rock characteristics that geologists use to help in the identification process.

Student's Information:

There are three basic rock classifications: igneous, sedimentary and metamorphic. **Igneous rocks** are formed when magma (molten rock) cools under the earth's surface or when the magma flows out on the earth's surface as **lava** and cools there. Most of the rocks at Morrow Mountain State Park have an igneous origin. As a matter of fact, 95% of the earth's crust to a depth of ten miles is made up of igneous rock.

Sedimentary rock is formed when loose mineral particles, or **sediment**, are deposited on land or water. With enough pressure from the weight of the layers above and the deep water, the particles get pressed into sedimentary rock. For example, if large amounts of volcanic ash build up on the bottom of lakes or oceans, the ash will be eventually pressed into a type of rock called **shale**. Sedimentary rock is always formed in layers, which is the easiest way to identify this type of rock. About 75% of the exposed surface rocks of the earth are sedimentary. These sedimentary rocks make up a relatively thin covering over the underlying igneous rocks. Shale, sandstone and limestone make up almost 99% of the sedimentary rocks, with shale being more common than sandstone and sandstone being more common than limestone.

Metamorphic rock is formed when either igneous or sedimentary rocks are put under enough heat and pressure over a long period of time to change the rock both physically and chemically. For example, by this metamorphic process shale is changed to slate, limestone to marble, and sandstone to quartzite. **Slate** can be seen along most of the park's streams.

Geologists have identified about 2,000 rocks, each with their own characteristics. To identify rocks, geologists look at hardness, color, the way crystals are arranged, layering, **minerals** and many other characteristics.

A rock is made up of one or more minerals, so one of the characteristics geologists look for is the type of minerals found in a rock and the ratio of minerals to one another. Each mineral always has the same chemical composition and its own particular crystalline structure. A mineral is a combination of one or more substances. Quartz, for example, is a combination of two elements, silicon and oxygen, and has a chemical formula of SiO_2. Quartz is a common mineral in the park. Gold is a mineral of just one element with the chemical formula (and symbol) of Au. Gold has been found in several locations in Stanly County but not in the park. Most minerals are made up of a combination of only eight elements. The following is a list of these elements with the percentage figure indicating their abundance in the earth's crust, and hence their approximate abundance in the rocks and soil around us.

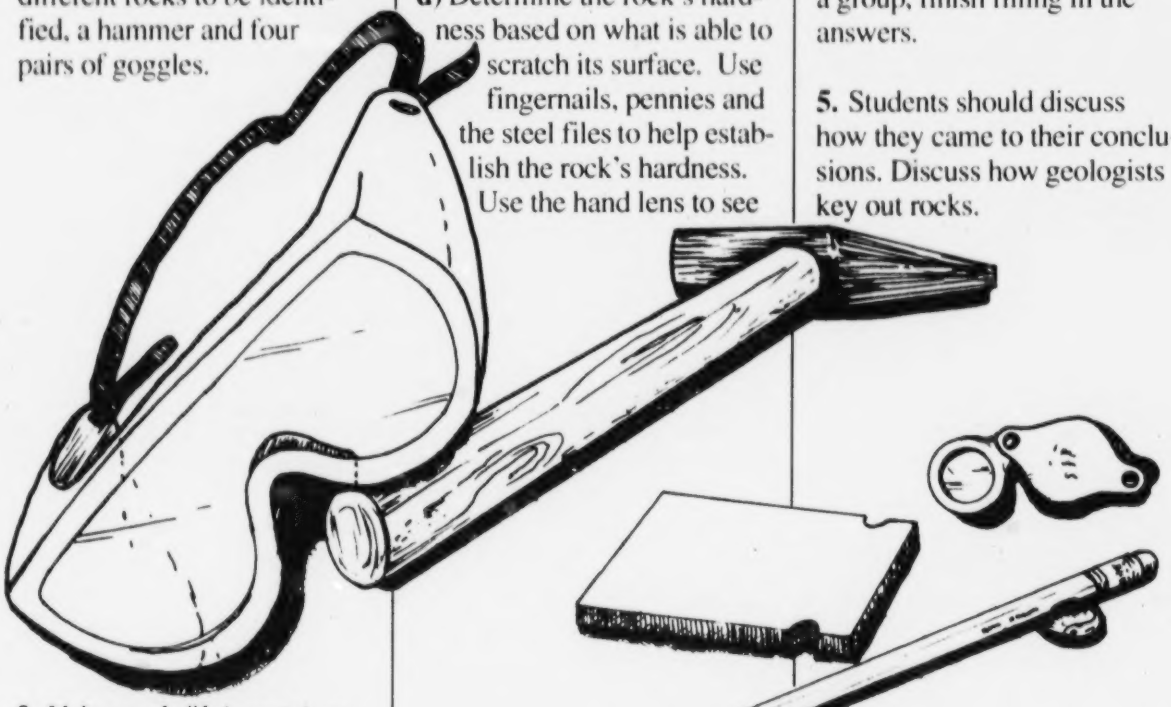
Element	Symbol	Percentage by Weight
Oxygen	O	46.7%
Silicon	Si	27.7%
Aluminum	Al	8.1%
Iron	Fe	5.1%
Calcium	Ca	3.7%
Sodium	Na	2.8%
Potassium	K	2.6%
Magnesium	Mg	2.1%
		98.8%

All other elements total less than 2%.

The relationship between a rock and its minerals can be compared to a fruit cake's relationship to its ingredients. If the rock is like the fruit cake, the minerals would be the raisins, nuts, cherries, candied fruit, sugar, flour, eggs, etc.

Instructions:

1. Divide the students into seven groups, one group placed at each station. At each station will be a pencil, a streak plate, a hand lens, a penny, a steel file, a "Rock and Mineral" fact sheet, the five different rocks to be identified, a hammer and four pairs of goggles.



2. Using rock #1 (quartz), as a class, have the students work through the characteristic tests below, with the leader directing and filling in the answers on the large identification worksheet.

a) Determine the rock's overall color. The hammers can be used to break the rock to see the color inside the rock. (This is important as the outside color may have been altered due to **weathering** factors.)

b) Note the color of the rock's streak when scratched on the unglazed porcelain plate.

c) Note the way the rock reflects light, its luster. Classify it as either glassy, dull or metallic.

d) Determine the rock's hardness based on what is able to scratch its surface. Use fingernails, pennies and the steel files to help establish the rock's hardness. Use the hand lens to see if any of these things made a scratch on a rock's surface. (See the "Rock Identification" worksheet for more information.)

e) Observe whether the rock has layers. Put yes or no in this column.

f) Use the "Rock and Mineral" fact sheet to determine the classification as to mineral, igneous, sedimentary or metamorphic, and the rock's name.

3. Have the students repeat the above steps for the other four rocks at their station.

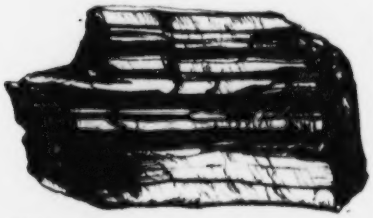
4. After the students' "Rock Identification" worksheets are complete, place the large identification worksheet where everyone can see it, and as a group, finish filling in the answers.

5. Students should discuss how they came to their conclusions. Discuss how geologists key out rocks.

Rock and Mineral Fact Sheet

Argillite or Slate

Slate is found along many of the park's streams and at a few mountainside locations. Slate is the metamorphosed form of shale. It has layers but is listed as having medium hardness as compared to weathered slate's soft nature. Its surface is dull, but is somewhat shiny if wet. A gray streak is produced on the scratch plate. Its layers are gray to black. Slate has been used for shingles for roofs, flooring, blackboards and building stone. Many of the park's buildings and curbs have been constructed from this rock which came from a quarry located within the park.



Weathered Argillite or Weathered Slate

The weathered slate found in the park and the surrounding area comes from the ash of ancient **volcanoes**. The ash from these volcanoes settled into layers on the bottom of shallow seas and was eventually **compacted** into rock by the pressure of the water and the ash layers above it, making shale. Eventually, enough heat and pressure metamorphosed the shale into slate. The slate has since weathered back to a softer form, called weathered argillite.

The two things that one notices right away about this rock are that it has layers and is very soft. You will be able to scratch it with your fingernail. It is classified as a metamorphic rock. Because of its layering, it is easy to determine that weathered slate comes from a sedimentary rock. It streaks yellow to brown on a scratch plate, and its layers range in color from black to light yellow to brown. Its luster is dull.

Basalt

Basalt is a common fine-grained rock. It is cooled magma that flowed out of volcanic cones or cracks in the earth. The ocean floor is made up of basalt that flowed out of trenches created from the movement of the earth's tectonic plates.

Basalt is gray-green in appearance and will leave a gray streak on the scratch plate. It has a dull luster and medium hardness. It is classified as igneous and of course has no layers. The green color comes from a mineral called **chlorite**.

In the park, basalt is found as round boulders at the bottom of hills and on hillsides.

Early European settlers in this area used this rock to build walls and fences. Some of these structures can still be seen when walking in the park.

Rhyolite

Rhyolite is even finer grained then basalt. Its crystals are too small to be seen even with a hand lens. Rhyolite, like basalt, is an **extrusive volcanic rock**. It is formed by very sluggish, thick and viscous magma flows from volcanoes and cracks. Rhyolite is classified as a hard, extrusive igneous rock. It is the main rock type found on the tops of the hills which make up the Uwharrie Mountains. It is very **resistant** to

weathering and **erosion** which is the reason that these mountains are still here after 500 million years.

Native Americans used rhyolite to make a variety of tools including scrapers, knives, axes, and spear and arrowhead points. Rhyolite tools made from the rock of the Uwharrie Mountains have been found from Florida to Maine.

Rhyolite is gray in color and often has white dots. It will leave a black streak on the scratch plate. It has a dull luster and is not layered.

Quartz

Whole books have been written about this mineral. It is a mineral found in many different types of rocks. Its chemical formula is SiO_2, which is called silicon dioxide. In its pure form, quartz will be clear, but it usually has impurities that give it a variety of colors including white, red, pink, smoky black, black, yellow, green and gray.

Quartz is considered to be hard because a file will barely scratch it, if at all. Its luster is glassy. Quartz does not have layers and is therefore not a sedimentary rock, although it is found in sedimentary rocks, as well as the other two rock types. A white streak is produced on a scratch plate with this rock.

Quartz often acts like a rock glue. When igneous and other rock types crack and the crack goes deep enough into the earth, often silicon dioxide will fill the crack and glue the rocks back together. If there is enough space, the quartz will develop into hexagonal crystals.

There are two interesting things about this rock glue called quartz. First, the glue is usually harder than the rocks it glues back together. This results in quartz being found on top of the soil after the rocks it has glued back together have weathered to soil. Second, when the silicon dioxide is traveling from deep in the earth, other minerals will sometimes come along with it, creating a quartz based rock. One of those minerals is gold. Tons of gold have been found in the southern piedmont of North Carolina, and it is primarily found in association with quartz.

Early European settlers in this area used quartz based rock to build walls and fences. Some of these structures can still be seen when walking in the park.

Worksheet for On-Site Activity #1						Rock ID	
Rock Sample	**Color**	**Streak**	**Luster**	**Hardness**	**Layered**	**Classification**	**Name**
1							
2							
3							
4							
5							

Color - the identifiable color. (Quartz may be colorless, white, pink, smoky, yellow or purple, depending on the impurities within it.)

Streak - the color a rock leaves behind when it is scratched across a streak plate or unglazed porcelain. (Quartz leaves a white streak.)

Luster - the way a rock reflects light. (Quartz has a glassy luster. Other minerals may have a dull or metallic luster or no luster at all.)

Hardness - if a rock can be scratched with a fingernail it is considered very soft. If it can be scratched with a penny it is considered soft, with a file it is medium, and with none of these items, the mineral is classified as hard. (Quartz usually cannot be scratched with a file, so it is hard.)

Layered - either a rock has layers or it doesn't. (Quartz does not have layers.)

Classification - a rock is classified as a mineral or as igneous, sedimentary or metamorphic. (Quartz is a mineral, and is sometimes found in all the other rock types.)

Answer Sheet for On-Site Activity #1 Rock ID

Rock Sample	Color	Streak	Luster	Hardness	Layered	Classification	Name
1	white clear pink	white	glassy	hard	no	mineral	quartz
2	brown to black to light yellow	yellow to brown	dull	very soft	yes	metamorphic	weathered slate
3	gray to black	gray	dull, shiny if smooth/ wet	medium	yes	metamorphic	slate or argillite
4	gray w/ white specks	black	dull	hard	no	igneous	rhyolite
5	gray to green	gray	dull	medium	no	igneous	basalt

Color - the identifiable color. (Quartz may be colorless, white, pink, smoky, yellow or purple, depending on the impurities within it.)

Streak - the color a rock leaves behind when it is scratched across a streak plate or unglazed porcelain. (Quartz leaves a white streak.)

Luster - the way a rock reflects light. (Quartz has a glassy luster. Other minerals may have a dull or metallic luster or no luster at all.)

Hardness - if a rock can be scratched with a fingernail it is considered very soft. If it can be scratched with a penny it is considered soft, with a file it is medium, and with none of these items, the mineral is classified as hard. (Quartz usually cannot be scratched with a file, so it is hard.)

Layered - either a rock has layers or it doesn't. (Quartz does not have layers.)

Classification - a rock is classified as a mineral or as igneous, sedimentary or metamorphic. (Quartz is a mineral, and is sometimes found in all the other rock types.)

On-Site Activity #2 — Water Over The Rocks

Curriculum objectives:
Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills, writing
- Guidance: group interaction
- Healthful Living: recreational safety
- Science: living things, plants, earth science, environment
- Social Science: organize and analyze information, draw conclusions, map use, participate effectively in groups

Grade 6
- Visual Arts: understand the role creativity plays in producing art
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills
- Guidance: group interaction, occupations
- Healthful Living: how people affect the environment, recreational safety
- Mathematics: measurement
- Science: ecology, earth science, environment
- Social Studies: gather, organize and analyze information, draw conclusions, map use

Grade 7
- Visual Arts: understanding the role creativity plays in producing art
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills
- Guidance: group cooperation, develop an awareness of alternative points of view
- Mathematics: measurement
- Science: characteristics of plants, soils, interactions of people and the environment, earth science, earth forms, natural phenomena
- Social Studies: gather, organize and analyze information, draw conclusions

Locations:
Lower picnic area and Quarry Trail

Group Size:
30 or less, one adult per 10 students

Estimated Time: 1 hour

Appropriate Season:
Warm weather

Materials:
Provided by the park:
15 magnifying glasses, 8 gold pans
Provided by the educator:
Per student: "Water Over the Rocks" worksheet, clip board, paper, pencil, completed "Rock ID" worksheet or "Rock ID" answer sheet

Special considerations:
Safety of students as well as protection of the stream area should be considered. The trail is rated as easy but does have several creek crossings and several short steep hills to climb and descend.

Major Concepts:
- Erosion
- Water cycle
- Rock cycle
- Use of stone

Objectives:
- Name one natural and one unnatural thing that has greatly effected the weathering of the rocks in the park.
- Explain how metamorphic rocks are formed and name one common to this area.
- Explain how sedimentary rocks are formed and how they are layered.
- Explain why rocks found in this area are no longer in a horizontal plane.
- Classify at least two rock positions found in the quarry.
- Observe and record the effects of moving water on rock surfaces.
- Name the type of stone used for building material in the park and explain why it was used.

Educator's Information:

Of all the land-shaping factors, water has the greatest effect. Large rivers, as well as small streams, work to shape the earth's surface, as you will see in the park. Flowing water, from the smallest trickle coming out of the hillside to huge, roaring waterfalls, is a sculptor of great power. Yet surprisingly, streams and rivers make up less than one one-thousandth of the earth's land surface and contain only .005 percent of the earth's liquid fresh water.

Particles of soil and sand suspended in the flowing water act as an abrasive agent, scouring rocks in the river or stream channel. This, in turn, creates more particles. This scouring explains why **rocks** in a stream or river bed have smooth edges. The edges have been worn away, not by the water but by the suspended particles of soil and sand in the water. Over time, the force of these streams and rivers shapes the landscape, cutting narrow gorges in steep mountains and wide flood plains in the piedmont and coastal areas.

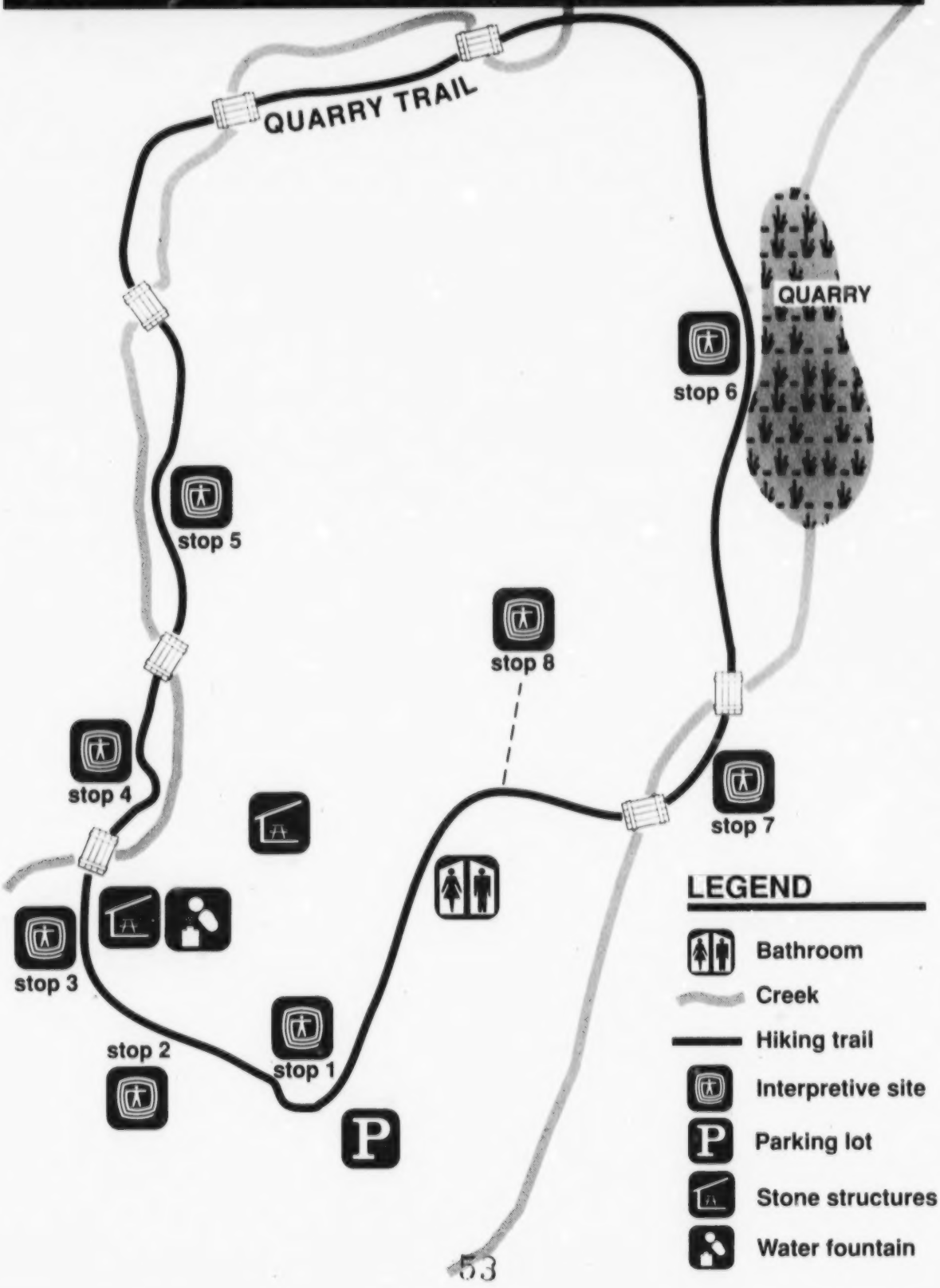
The streams in the park have shaped their surroundings. The level flood plain along the Yadkin River was formed by deposits of sand eroded from rocks upstream and **sediment** that was washed into the stream and then carried onward by the river's current.

Another way flowing water shapes the landscape occurs during floods. With the increase of water power during floods, large and small rocks roll and tumble, grinding against each other and scouring the river's bed. The rising waters wash soil and sand, trees and shrubs out from one location and deposit them further downstream.

It is estimated that a grain of sand takes a million years to travel 100 miles down a river like the Yadkin. This progress toward the ocean has been slowed even further by the construction of dams. But rocks have a different time perspective than you and I. Whether it takes a million or a billion years, the **rock cycle** still circles through its different phases.

Water is recycled by **evaporation** from the land and ocean. It returns to the earth in the form of rain, snow, hail and mist. Much of the water falling from the sky runs off into our streams and rivers or filters through the soil and through joints and cracks in the bedrock into the groundwater. The groundwater connects with the rivers, lakes, and oceans. These waters are eventually evaporated, beginning the cycle once again.

Water Over the Rocks Trail Map



Trail Guide for Water Over the Rocks

Trail Description:

The activity "Water Over the Rocks" will take you on a trail approximately 1/2 mile long, called the Quarry Trail. It starts in the picnic area, follows a winding creek around the base of a hill, and crosses the creek several times before leaving it. The trail then crosses a small hill and travels down to another creek that passes through the old quarry site. The trail leads you around the quarry and back up the hill to the picnic area.

The quarry is a good example of **bedding** in **slate**. The bedding is inclined at a steep angle, indicating that the rock has been tilted from its original horizontal position. Fractures developed parallel to the bedding planes and also at angles to it.

First Things First

Before going on the trail, have the students take a break and use the restrooms. The students will not be hiking far, but the hike will take approximately 1 hour due to the amount of material being covered.

Stop 1

When the group has reassembled, show them a large topographic map of the park area, and trace on the map where the students will be hiking. Explain the map's symbols. Hand out the "Water Over the Rocks" worksheets, if the students don't already have them, and have the students answer the questions on them at the appropriate stops. Use the answer sheet to facilitate questions and discussion.

Stop 2

The type of forest located in a particular area is directly related to the area's geology and how the land has been shaped over time. The soil type, elevation, latitude, slope and compass direction the slope faces all affect the type of plant communities that will grow in a given location. For example, certain plant species prefer an acidic soil, while others thrive in a neutral or alkaline soil. Some species grow only at a certain elevation, others grow at specific latitudes, slopes, or faces. Plant communities can often tell a trained scientist a lot about the soil, the base rock and the geologic history of an area.

Stop 3

Notice the blue slate rock that was used to construct the structures around you. The picnic shelter, water fountain, and barbecue pit grill were all constructed by the **Civilian Conservation Corps**, (known as the CCC), during the late 1930's and early 1940's. Farther down the trail, you will pass through the quarry where the slate was dug. Discuss other places you might have noticed in the park where this rock was used. Parking lots, retaining walls, the swimming pool, the bathhouse, and many other park facilities are constructed of this same type of slate. Slate was also used as head and foot markers at grave sites located in the park. Discuss the worksheet questions and answers.

Choose one piece of slate used in the construction of the barbecue pit, water fountain or picnic shelter and draw its edge, showing the layers. Be sure to look for fossils in the rock. Fossils are extremely rare but three have been found in Stanly County. You might get lucky and find a fourth.

Pteridinium fossil

Stop 4

A. Situate the students at a stream location and ask them to make the following observations while completing their worksheet. Are there exposed rock outcrops in the water? in the stream bank? What type might they be and why are they located here? What are their shapes?

B. Observe the rock that was uncovered on this hillside due to the erosion of the loose soil. This is weathered slate. It was formed from slate that has weathered back to a softer state. The weathered slate is much softer than slate and is not suitable for building material. Take a piece of the weathered slate and experience how soft it is by crumbling it in your hands.

C. Have the students examine and draw the stream sediments as seen through a magnifying glass. Discuss the sediments' colors and shapes, the types of rocks they came from, why they are here, and where they are going.

D. Have the students draw a rock found in the stream and one located away from the stream. Have them describe these two rocks.

E. Discuss with the students how floods roll and sort rocks in the streams. Have them answer the worksheet questions, looking for clues to flood heights such as scouring and debris deposited in the flood plain along the stream.

Stop 5

Look along the inside bend of the stream. Discuss how as the current slows, heavier material is deposited, forming a sandbank. This sandbank is made up of rocks and minerals. Using the gold pans, have the students "pan" for rocks and see how many different types of rocks they can identify using their completed "Rock ID" worksheets or the "Rock ID" answer sheet.

Stop 6

Slate was mined from this quarry years ago. It was used for structures like the ones you saw at the beginning of the trail. On the right side of the quarry the rock located on top of the layered slate, at the highest point on the quarry walls, is one that you looked at earlier on the trail. It is weathered slate. Its location on top of the slate means that it was deposited at a later date, so it is a "younger" rock than that at the bottom of the quarry. The weathered slate has "decayed" back to a softer rock.

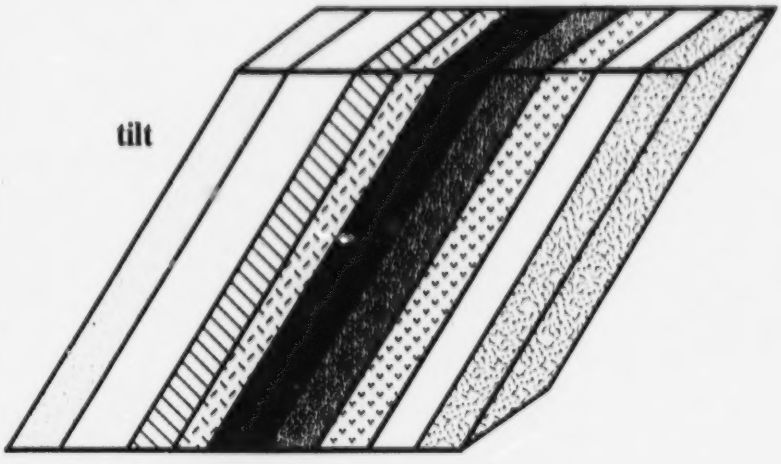
Walk over to the outcrops on the left side of the quarry. Notice how tilted the layers are. Have the students answer the worksheet questions, and then discuss their answers. Have the students identify and draw the following geological formations: tilts, breaks, and layers.

Stop 7

Notice the channels cut by the running water where the water runs over the exposed rock at the bridge. Answer the worksheet questions and discuss them.

Stop 8

To get an overall view, at this high point on the hill, look back over where you have been. Review with the students the erosional processes, the effects the stream and humans have had on shaping the landscape, the types of rocks you have seen, and what processes caused the rocks to tilt and break.



Be sure to mention that rhyolite and basalt, two of the major rock types in the park, are not found along this trail. Rhyolite forms the higher hills in the Uwharries. Basalt can be found scattered about the park on and below the surface, with the largest concentration being in the northwestern section of the park.

Also mention that North Carolina State Parks were set aside to protect unique natural areas throughout the state. Our state parks are true sanctuaries. All resources in the park are protected and may not be removed, molested or harmed. This includes all wildlife, all plants and even the rocks we are studying today. After the discussion, head back to the picnic area and trail head.

Suggested Extensions:

1. You may wish to visit the following places: A) The top of Morrow Mountain is a good place to see rhyolite, how it weathers and how it protects the mountain from wearing down. There is also a geological display located in the picnic area on top of the mountain; B) Basalt fields may be seen on the way to the top of Morrow Mountain. Fields of basalt can also be seen by parking at the trail head of the Sugarloaf Trail and walking a short distance down the trail. There is also a quartz outcrop approximately 100 yards down the Sugarloaf trail; C) Reed Gold Mine is located on NC Route 200 in Cabarrus County.

2. Come back to the park for a plant community hike on this same trail. This hike will relate the plant communities, geology, soils and geography.

Worksheet for On-Site Activity #2 Water Over The Rocks

Stop 3

What type of rock is slate?_____

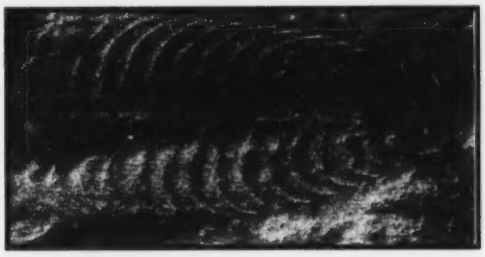
Why does it make such good building material?_____

_____

_____

Choose one piece of slate used in the construction of the barbecue pit, water fountain or the picnic shelter and draw its edge, showing the layers.

Be sure to look for fossils in the rock. They are extremely rare but three have been found in Stanly County in rocks just like these. You might get lucky and find a fourth.



Pteridinium fossil

Stop 4

A. Are there exposed rock outcrops in the water? _____Yes _____No

In the stream bank? _____Yes _____No

If so, what type(s) of rock do you think they are? _____

Why are they located there? _____

_____

_____

What shapes do these outcrop rocks have? are they smooth edged? rounded? jagged? sharp?

_____

_____

_____

_____

C. Draw the sediments as seen through the magnifying glass.

Describe the colors and shapes you see. Which type of rock do you think these sediments are from? Why do you think they are here, and where do you think they are going?

_____

_____

_____

_____

_____

_____

D. Drawing a rock found in the stream and one located away from the stream. Describe these two rocks.

stream rock	non-stream rock
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

E. Can you tell how high the last flood was (by the scouring along the stream)? ____Yes ____No

How high was it above the current water level? _____ feet _____ meters.

Can you tell how high the highest flood was (by the height of debris piled in the flood plain along the stream)? _____Yes _____No _____Maybe

How high was it above the current water level? _____ feet _____ meters

Stop 5

Use your "Rock ID" worksheet or the "Rock ID" answer sheet and see how many rocks you can identify as you pan the sandbank at the stream bend.

Stop 6

Notice how tilted the layers in these outcrops are. What do you think caused this?

What angle were the layers at originally? _____

Draw the different types of geologic formations in the outcrops found in the quarry and label them as tilts, breaks/cracks or layers.

Stop 7

Notice the channels cut into the rock that the water is running over. What caused these channels to be cut? _____

What type of rock is the stream cutting through? _____

What type of rock is along the stream bank? _____

How do you think this rock was originally formed?_____

If the channel is being cut by small particles in the water, what happens to these suspended particles and those worn from the rocks? Where do they go? _____

Stop 8

At a high point on the hill, overlooking the quarry, look back over where you have been and review the erosional processes, the effects the stream and humans have had on shaping the landscape, the types of rocks you have seen, and what processes have caused the rocks to tilt and break. Write down any summary comments you would like to make.

Answer Sheet for On-Site Activity #2 Water Over the Rocks

Stop 3

What type of rock is slate?
(ANSWER: Slate is a metamorphic rock.)

Why does it make such good building material?
(ANSWER: The layers in this metamorphosed sedimentary rock will break along the planes in which the ash deposits were laid down. This results in a flat surface, which makes slate a great building material as the rocks can be stacked on top of one another.)

Choose one piece of slate used in the construction of the barbecue pit, water fountain, or the picnic shelter and draw its edge, showing the layers.

Be sure to look for fossils in the rock. They are extremely rare but three have been found in Stanly County in rocks just like these. You might get lucky and find a fourth.

Stop 4

A. Are there exposed rock outcrops in the water? __**X**__ Yes _____No

In the stream bank? __**X**__ Yes _____No

If so, what type(s) of rock do you think they are?
(ANSWER: metamorphic rock - eroded slate.)

Why are they located there?
(ANSWER: the stream exposed the rock.)

What shapes do these outcrop rocks have? are they smooth edged? rounded? jagged? sharp?
(ANSWER: smooth, rounded edges for in-water outcrops, jagged, sharp edges for stream bank outcrops.)

C. Drawing the sediments as seen through the magnifying glass. Describe the colors and shapes you see. Which type of rock do you think these sediments are from?
(ANSWER: mineral - quartz, metamorphic - slate and maybe igneous - basalt and/or rhyolite.)

Why do you think they are here, and where do you think they are going?
(ANSWER: they were eroded from the stream bed and bank here and farther upstream. They are on their slow way to the ocean.)

D. Draw a rock found in the stream and one located away from the stream. Describe these two rocks.
(ANSWER: The rocks found in the stream have been worn down by the stream, and will probably have smoother, rounded edges compared to the rocks found away from the stream.)

stream rock

non-stream rock

E. Can you tell how high the last flood was (by the scouring along the stream)? _X_ Yes ____No.

How high was it above the current water level? _____ feet _____ meters.

Can you tell how high the highest flood was (by the height of debris piled in the flood plain along the stream)? _____Yes _____No _____Maybe.

How high was it above the current water level? _____ feet _____ meters.

Stop 5

Use your "Rock ID" worksheet or the "Rock ID" answer sheet and see how many rocks you can identify as you pan the sandbank at the stream bend.
(ANSWER: Likely rocks are slate, rhyolite, quartz, weathered slate and basalt.)

Stop 6

Notice how tilted the layers in these outcrops are. What do you think caused this?
(ANSWER: The tilt of the slate is the result of crustal upheavals that occurred after the slate was originally formed.)

What angle were the layers at originally?
(ANSWER: The layers were originally horizontal with the ground.)

Draw the different types of geologic formations in the outcrops found in the quarry and label them as tilts, breaks/cracks or layers.

Stop 7

Notice the channels cut into the rock that the water is running over. What caused these channels to be cut?
(ANSWER: They were cut by the particles suspended in the water acting as sandpaper, wearing down the rock, day and night, over a very long period of time. It is a long, slow process but the earth's life is measured in millenniums and not in years.)

What type of rock is the stream cutting through?
(ANSWER: It is slate.)

What type of rock is along the stream bank?
(ANSWER: The rock is slate just like that the stream is cutting through.)

How do you think this rock was originally formed?
(ANSWER: It was formed when volcanic ash and silt were deposited in the still water of the old quarry site. There they were put under extreme pressure and compressed into the sedimentary rock, shale. Over time, pressure and heat transformed the shale into the metaphoric rock, slate.)

If the channel is being cut by small particles in the water, what happens to these suspended particles and those worn from the rocks? Where do they go?
(ANSWER: They are washed downstream and become part of the erosion process. Some settle in deeper and quieter areas of the stream.)

Stop 8

At a high point on the hill, overlooking the quarry, look back over where you have been and review the erosional processes, the effects the stream and humans have had on shaping the landscape, the types of rocks you have seen, and what processes have caused the rocks to tilt and break. Write down any summary comments you would like to make.
(Note: For assistance in the discussion, review the worksheet questions.)

Post-Visit Activity #1 What's Your Crystalline Structure?

Curriculum Objectives:
Grade 5
- Communication Skills: reading and vocabulary comprehension, study skills
- Science: earth science, environment

Grade 6
- Communication Skills: reading and vocabulary comprehension, study skills
- Science: earth science, environment

Grade 7
- Communication Skills: reading and vocabulary comprehension, study skills
- Science: scope of earth science, earth forms, natural phenomena

Location:
Classroom

Group Size:
Approximately 30 students plus teacher

Estimated Time:
30 minutes

Materials:
Provided by the educator:
Per student:"What's Your Crystalline Structure" worksheet, "Crystal Word Search Puzzle", pencil

Educator's Information:

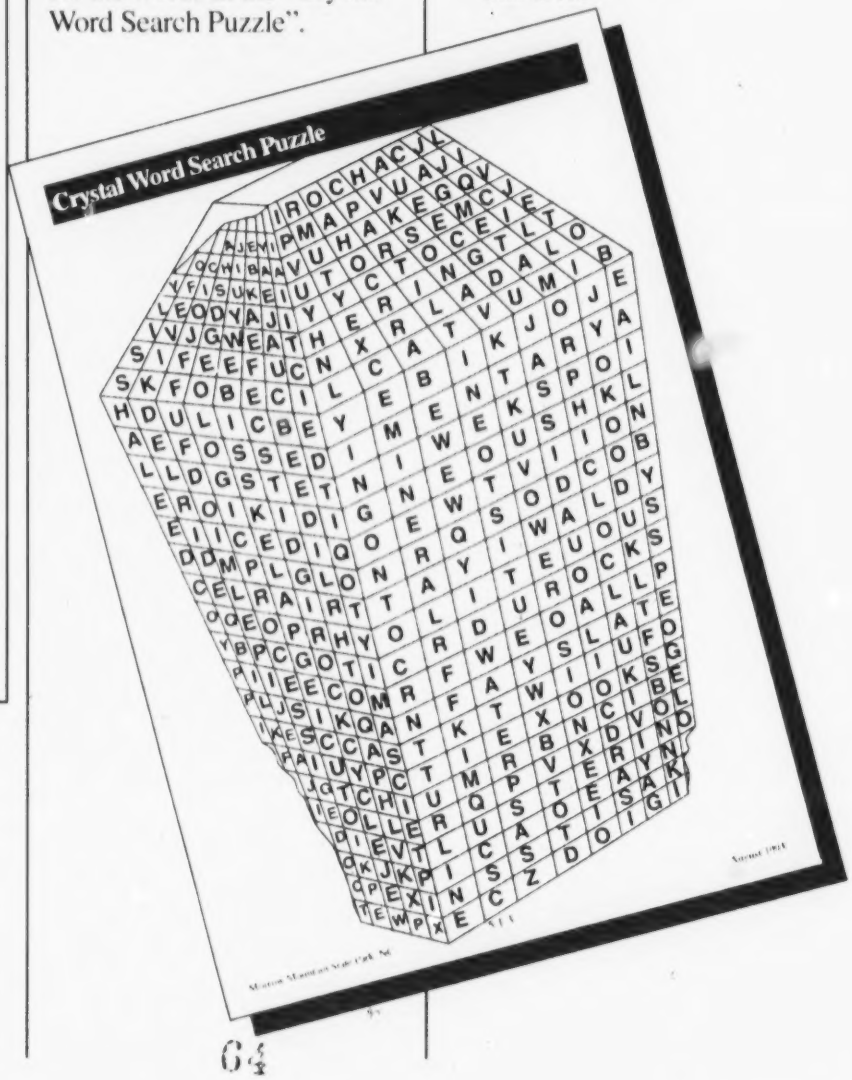
This activity is a review of the vocabulary and major concepts used throughout the whole packet. The students will first fill in the blanks with the appropriate word suggested by each definition or example. When the worksheet has been completed, the students will then search for the words in the "Crystal Word Search Puzzle".

Major Concepts:

- Geologic processes
- Geologic cycle
- Vocabulary

Objectives:

- Name the three basic rock types and explain how they are formed.
- List two geologic processes.
- Describe what a rock is and name two rocks common to this area.



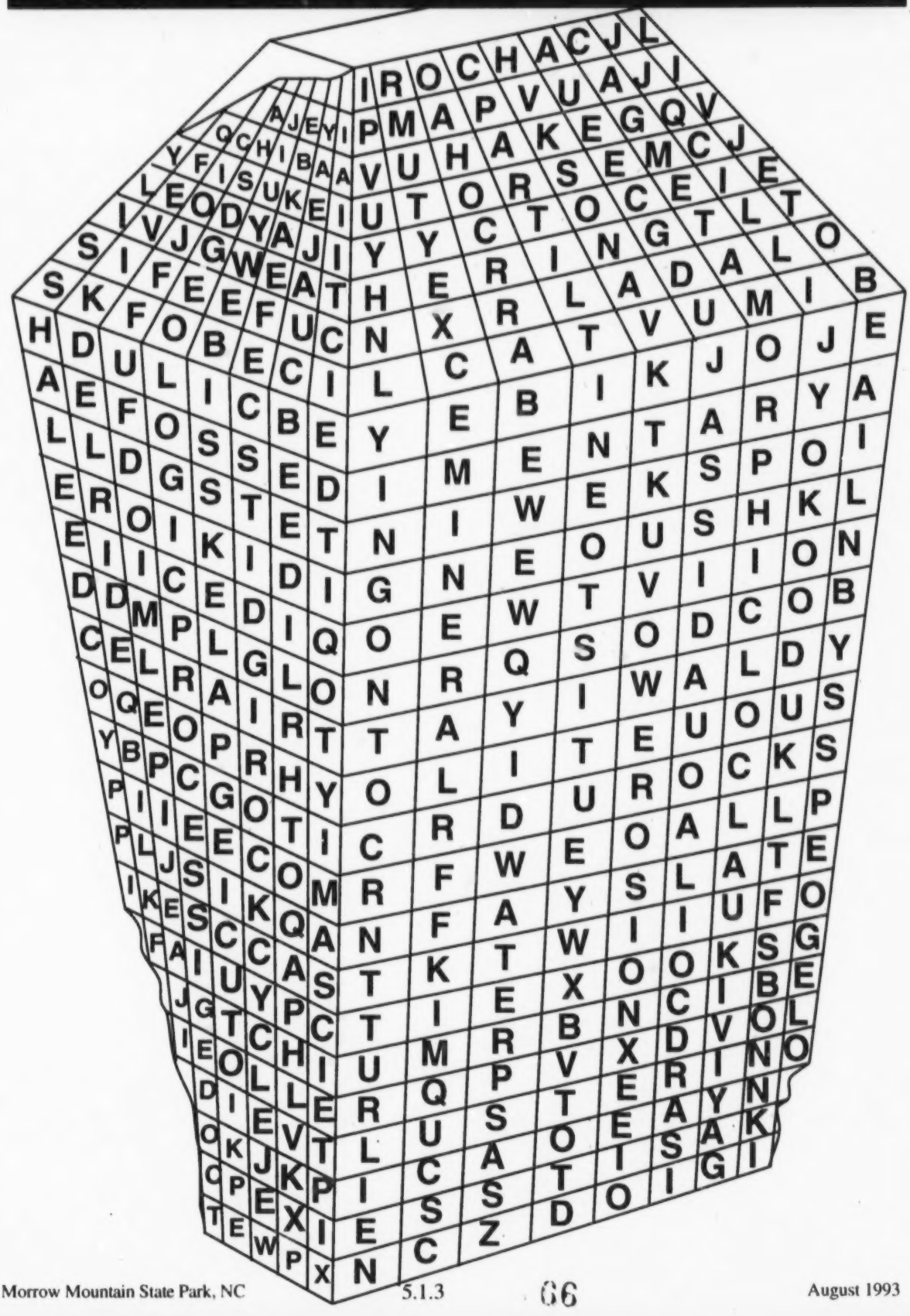
Worksheet for Post-Visit Activity #1 What's Your Crystalline Structure?

Fill in the blanks with the appropriate word suggested by each definition or example. When all words have been placed, find the words in the crystal word search puzzle.

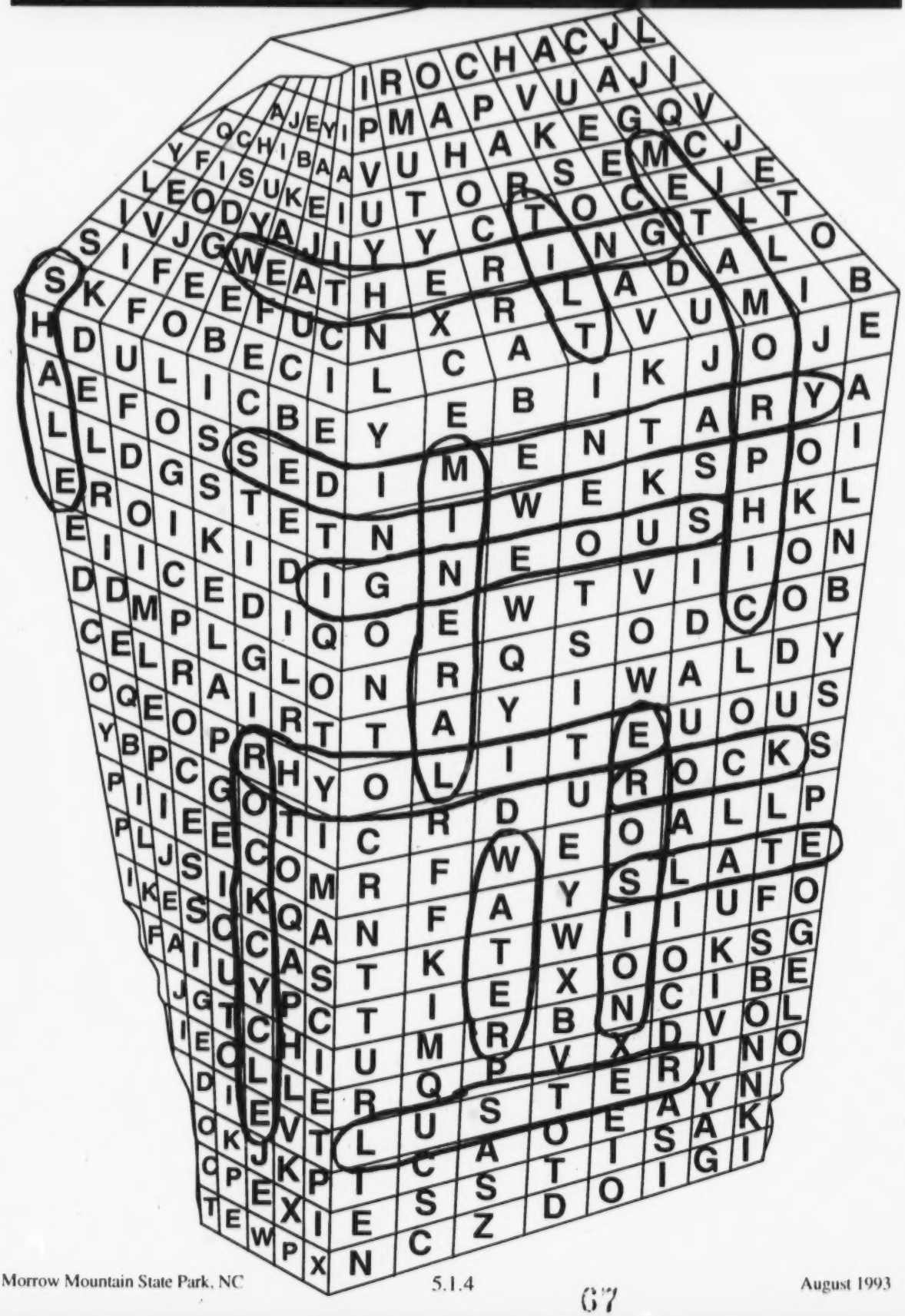
1. Substance made up of one or more minerals. _ _ _ _ _
2. Rocks exposed on the higher peaks and ridges of the Uwharrie Mountains. _ _ _ _ _ _ _ _ _ _
3. Metamorphosed sedimentary rock formed from volcanic ash, which breaks along a plane and is used as a building material. _ _ _ _ _ _
4. Naturally occurring substance with its own crystal shape. _ _ _ _ _ _ _ _
5. Rock type formed when heat and pressure change sedimentary or igneous rock. _ _ _ _ _ _ _ _ _ _ _ _ _ _
6. Term used when water carries away rock debris. _ _ _ _ _ _ _ _
7. Rock type formed when sediment settles and is pressed together. _ _ _ _ _ _ _ _ _ _ _ _ _ _
8. Process whereby sedimentary rocks become metamorphic rocks, metamorphic become igneous, igneous become sedimentary, etc. _ _ _ _ _ _ _ _ _ _ _ _ _
9. Used to classify rock types, usually dull or glassy. _ _ _ _ _ _ _
10. Destructive process that wears down rocks. _ _ _ _ _ _ _ _ _ _ _ _
11. The phenomena of how the earth is shaped. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
12. Rock type formed by volcanoes. _ _ _ _ _ _ _ _
13. Change in rock angle due to upheavals of the crust. _ _ _ _ _
14. The most consistent land shaping factor. _ _ _ _ _ _
15. The sedimentary rock type from which slate is formed. _ _ _ _ _ _

ROCK	**RHYOLITE**	**SLATE**
MINERAL	**METAMORPHIC**	**EROSION**
SEDIMENTARY	**ROCK CYCLE**	**LUSTER**
WEATHERING	**GEOLOGIC PROCESS**	**IGNEOUS**
TILT	**WATER**	**SHALE**

Crystal Word Search Puzzle



Crystal Word Search Puzzle Answer Sheet



Answer Sheet for Post-Visit Activity #1 What's Your Crystalline Structure?

Fill in the blanks with the appropriate word suggested by each definition or example. When all words have been completed, find the words in the crystal word search puzzle.

1. Substance made up of one or more minerals. **R O C K**
2. Rocks exposed on the higher peaks and ridges of the Uwharrie Mountains. **R H Y O L I T E**
3. Metamorphosed sedimentary rock formed from volcanic ash, which breaks along a plane and is used as a building material. **S L A T E**
4. Naturally occurring substance with its own crystal shape. **M I N E R A L**
5. Rock type formed when heat and pressure change sedimentary or igneous rock. **M E T A M O R P H I C**
6. Term used when water carries away rock debris. **E R O S I O N**
7. Rock type formed when sediment settles and is pressed together. **S E D I M E N T A R Y**
8. Process whereby sedimentary rocks become metamorphic rocks, metamorphic become igneous, igneous become sedimentary, etc. **R O C K C Y C L E**
9. Used to classify rock types, usually dull or glassy. **L U S T E R**
10. Destructive process that wears down rocks. **W E A T H E R I N G**
11. The phenomena of how the earth is shaped. **G E O L O G I C P R O C E S S**
12. Rock type formed by volcanoes. **I G N E O U S**
13. Change in rock angle due to upheaval of the crust. **T I L T**
14. The most consistent land shaping factor. **W A T E R**
15. The sedimentary rock type from which slate is formed. **S H A L E**

ROCK	**RHYOLITE**	**SLATE**
MINERAL	**METAMORPHIC**	**EROSION**
SEDIMENTARY	**ROCK CYCLE**	**LUSTER**
WEATHERING	**GEOLOGIC PROCESS**	**IGNEOUS**
TILT	**WATER**	**SHALE**

Post-Visit Activity #2 — Geology Jeopardy

Curriculum Objectives:

Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension, speaking techniques
- Guidance: group interaction
- Science: earth science, environment
- Social Science: organize and analyze information, draw conclusions, participate effectively in groups

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension, speaking techniques
- Guidance: group interaction
- Science: earth science, environment
- Social Studies: organize and analyze information, draw conclusions

Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension, speaking techniques
- Guidance: group cooperation
- Science: earth science, earth forms, natural phenomena
- Social Studies: organize and analyze information, draw conclusions

Locations:
Inside or outside, depending on the weather

Group Size:
30 or less, larger groups can be accommodated

Estimated Time:
30 minutes

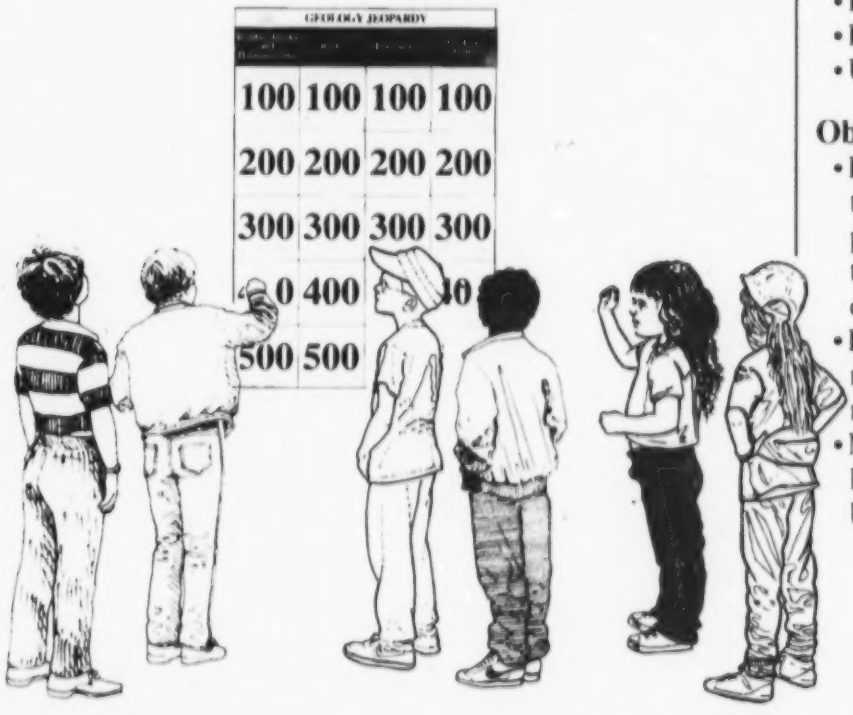
Materials:
Provided by the educator:
"Geology Jeopardy" board

Educator's Information:

This game is adapted from the television game show, Jeopardy. Before starting the game be sure to briefly review the geologic history of the park in the Appendix (8.1). This is a fun way for the students to evaluate themselves on what they have learned through the previous activities. The game also provides good factual information on geology and the Uwharrie Mountains, in particular. You may wish to award prizes or recognition to the participants with the highest score.

Major Concepts:
- Rock formations
- Landforms
- Rock composition
- Use of native stone

Objectives:
- List the three most common types of rock found in the park and state which rock type is highly resistant to erosion.
- Explain how sedimentary, metamorphic and igneous rocks are formed.
- Name two rock types and how they have been used by humans in this area.



Instructions:

Divide the class into three teams. Put each team in a line facing the Jeopardy Board. Ask one of the three students at the head of the lines to pick the first number amount and category column to be revealed. The amounts do not have to be selected in any particular order.

When the category and the amount have been selected, uncover the "answer" and read it aloud to the group. The first of the three students at the head of the lines to raise a hand gets a chance to respond. (It is extremely helpful to have someone familiar with the group to watch for the first hand raised, since the leader will be reading the "answers".)

The correct response must be in the form of a question. If the first student answers incorrectly, the other two students are given a chance to raise their hands and respond. The student who correctly responds by asking "What is _____?," receives the point value card and gets to select the next category and amount to be revealed. If no correct response is given, the leader gives the response.

All three participants now move to the back of the lines and the next three students have a chance to answer the next question.

After all columns have been uncovered, each team adds up their point cards to determine who has the most points. If any prizes are to be awarded, that is done at this time.

Suggested Extensions:

Play another television game called Win, Lose or Draw. Geological terms or processes are written on index cards which are placed face down on a table close to the chalkboard where the drawings will be done. Try to have different colors of chalk available.

Divide the class into two groups. Each group will chose someone to draw for that group. One point is given for each correct guess. The first group's "artist" has one minute to convey a geological term or process in pictures to their group. If the group doesn't guess the correct answer in one minute then the other group has a chance to guess what was being drawn. If neither group gets the correct answer, the moderator (usually a teacher) gives the answer.

It is now the second group's turn. A new index card is taken from the stack and the second group's "artist" draws a picture to convey the term to their group. Suggestions for geological terms or processes that could be used are: **erosion**, **weathering**, glaciers, **sedimentary rock**, **igneous rock**, **metamorphic rock**, fossils, **volcanoes**, etc.

GEOLOGY JEOPARDY

Building Blocks and Hammerstones	Rocks	Landmarks	Geologic Terms
100	100	100	100
200	200	200	200
300	300	300	300
400	400	400	400
500	500	500	500

GEOLOGY JEOPARDY

Building Blocks and Hammerstones	Rocks	Landmarks	Geologic Terms
The stone Native Americans used to make tools such as knives, spearpoints and arrowheads.	A sedimentary rock formed from volcanic ash, silt and sand that settled in quiet bodies of water.	936 feet above sea level.	A place where building rocks are mined.
The rock the CCC quarried in the park and used to build walls and buildings.	An igneous rock that is found on all the higher hills in the Uwharries, and reduces the rate at which they erode.	This mountain range is made of rocks formed 500 million years ago.	The rock type (such as slate) created by heat and pressure on rocks.
The rocks early settlers picked and stacked up to make stone walls and fences.	A weathered rock that can be scratched by your fingernail.	Located at the southern end of the Uwharrie Mountain range.	Rocks formed by the cooling of hot, molten rock on or below the surface of the earth.
The type of rock that makes up 95% of the rocks on earth.	A white, hard rock which acts as rock glue.	The bedrock of this region.	Movement of weathered rock by water, wind and glacial action.
The rock formation that formed the "Great Falls of the Yadkin" before a dam was built in the early 1900's	The mineral that gives basalt its greenish color.	The primary cause of erosion of the earth.	The rock type formed when sediments are compacted and/or cemented together.

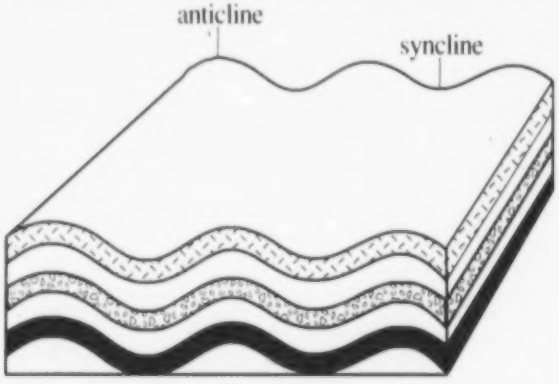
GEOLOGY JEOPARDY - Correct Responses

Building Blocks and Hammerstones	Rocks	Landmarks	Geologic Terms
What is rhyolite?	What is shale?	What is the elevation of Morrow Mountain?	What is a quarry?
What is slate?	What is rhyolite?	What is the Uwharrie Mountain range?	What is metamorphic rock?
What is basalt or quartz?	What is weathered slate or weathered argillite?	What is Morrow Mountain State Park?	What is igneous rock?
What is igneous rock?	What is quartz?	What is slate?	What is erosion?
What is rhyolite or dike?	What is chlorite?	What is moving water? or What is water containing sediment?	What is sedimentary rock?

VOCABULARY

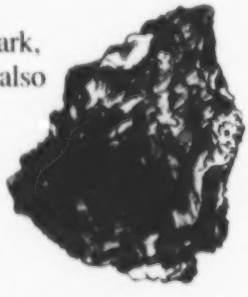
Aggregate - composed of a mixture of minerals that may be separated by mechanical means.

Anticline - an upfold or arch of stratified rock.



Argillite - the type of slate found at Morrow Mountain State Park. (For further information see the "Rock and Mineral" factsheet in On-Site Activity #1 - Rock ID.)

Basalt - a hard, dense, dark, extrusive volcanic rock, also called green stone. (For further information see the "Rock and Mineral" factsheet in On-Site Activity #1 - Rock ID.)



Bedding - the formation of layers or strata in sedimentary and metamorphosed sedimentary rock.

Civilian Conservation Corps (CCC) - a federal government program of the 1930's and 1940's that was established to provide jobs and develop public properties.

Chlorite - a generally green or black mineral often found in the basalt in the park.

Compaction - the process or state of being pressed together; compacted.

Crustal plates - granitic plates on which the continents ride. When these plates collide they push up mountains and create metamorphic rock due to the pressure of their collision.

Decay - to decompose; rot.

Decomposition - the chemical breakup of rock at or near the earth's surface. The mineral components of the rock are altered and new compounds are produced.

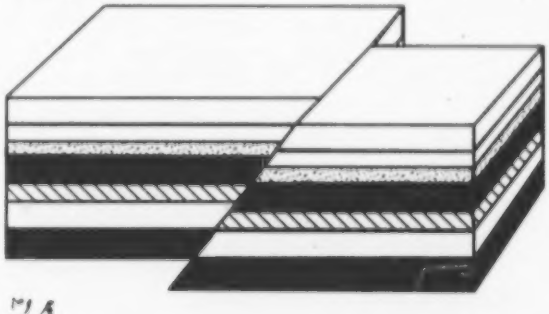
Dike - an intrusive, more or less vertical, thin sheet of igneous rock.

Earth's crust - a rigid shell only about 30 miles thick, less than one hundredth of the distance to the center. Eight elements account for almost 99% of the earth's crust - oxygen (46.7%), silicone (27.7%), aluminum (8.1%), iron (5.1%), calcium (3.7%), sodium (2.8%), potassium (2.6%), and magnesium (2.1%).

Erosion - the movement of bits of weathered rock by wind, water, gravity and glacial action.

Extrusive igneous rock - rock formed by the cooling of molten lava on the earth's surface. Examples found in the park are rhyolite and basalt.

Faulting - in geology, a fracture of the earth in which layers of rock slide up or down along the break.



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Folding - to bend over or double up so that one part lies on another part.

Geologic process - the breaking down and building up of rocks, such as weathering, erosion, sedimentation and volcanic action; the phenomena of how the earth is shaped

Hypothesis - a proposed or possible answer to a problem; a premise from which a conclusion is drawn.

Igneous rock - rock formed by the cooling of molten rock on or under the surface of the earth; rock formed by volcanoes. The crust of the earth is approximately 95% igneous rock. Examples found in the park are rhyolite and basalt.

Intrusive igneous rock - igneous rock that forms when magma cools inside the earth, usually course-grained mineral crystals.

Lava - molten rock that issues from a volcano or a fissure in the earth's surface; the rock formed by the cooling and solidifying of this substance.

Luster - the appearance of a rock surface judged by its brilliance and ability to reflect light.

Magma - molten rock beneath the earth's surface. When it reaches the earth's surface, it is called lava.

Mantle - in geology, the layer of the earth between the crust and the core.

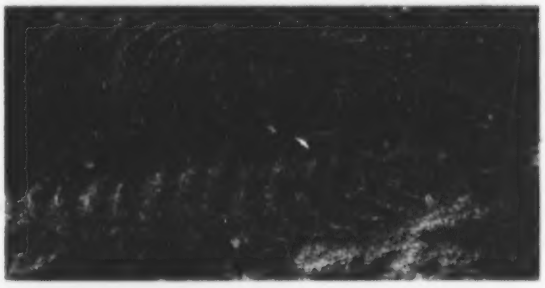
Metamorphic rock - sedimentary or igneous rocks that have been altered chemically and/or physically by great heat and pressure. Slate is a metamorphic rock found in the park.

Minerals - one or more chemical elements that make up the earth's rocks. They are inorganic and occur naturally. Each mineral has its own chemical make-up, as well as its own characteristic crystal shape. Quartz is a common mineral found in the park.

Outcrop - an area of exposed rock. Examples are road cuts, stream beds and quarries.

Quartz - a hard crystalline mineral of silicon dioxide, SiO_2. (For further information see the "Rock and Mineral" factsheet in On-Site Activity #1- Rock ID.)

Pteridinium - a precambrian animal whose fossil is found in slate in the Stanly County region. There is much disagreement about how this soft-bodied lobed animal looked, however, most researchers believe the animal lived a solitary existence on the ocean floor.

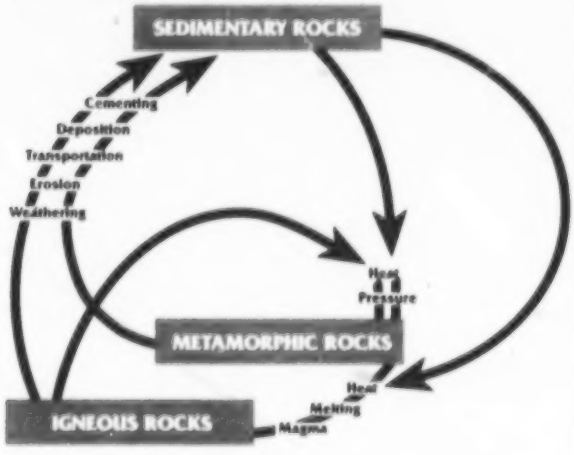


Resistant rock - rock that weathers and erodes more slowly than other rock in the same area.

Rhyolite - a glassy, volcanic rock, similar to granite in composition, which usually exhibits flow lines. This is the most prominent rock on the tops of the Uwharrie Mountains. Used by Native Americans to make tools and projectile points. (For further information see the "Rock and Mineral" factsheet in On-Site Activity #1 - Rock ID.)

Rock - a substance made up of one or more minerals. Rocks are an important part of the earth's crust, mantle, and core. There are three forms of rock: igneous, sedimentary, metamorphic.

Rock cycle - the process whereby one rock type changes into another.



Sediment - material that settles to the bottom of a liquid, such as soil being washed into a lake and settling to the bottom.

Sedimentary rock - rock made by the compaction and/or cementing of sediments.

Shale - a sedimentary rock composed of laminated layers of clay-like, fine-grained sediments, such as volcanic ash. The slate found in the park is metamorphosed shale.

Slate - a fine-grained metamorphic rock formed from volcanic ash, that splits into thin, smooth-surfaced layers; often used as a building material. (For further information see the "Rock and Mineral" factsheet in On-Site Activity #1 - Rock ID.)

Syncline - a downward fold in sedimentary rocks. (See Anticline.)

Vent - an exit hole for hot gases and lava to flow from a volcano.

Volcanic rock - rocks produced by or discharged from a volcano.

Volcano - a vent in the earth's crust through which molten lava and gases are ejected; a mountain formed by the materials so ejected.

Weathering - any of the chemical or mechanical processes by which rocks exposed to the weather decay to soil. In the broadest sense, any of the destructive elements that wear down rocks, causing them to fragment, crack, or crumble. Examples include heat, chemicals, wind, water and ice. (Erosion loosens and carries away debris caused by weathering.)

Xenolith - literally, a "stranger" rock, which was surrounded during the movement of magma to form an unrelated inclusion within the surrounding igneous rock.

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Summary of the Uwharrie Mountains Geology

This northeast-treading mountain range, called the Uwharries, is considered by geologists to be a very ancient geological formation. Although estimates vary considerably, most sources agree that the cataclysmic volcanic eruptions and uplifting processes that formed these mountains began late in the Cambrian period, well over 500 million years ago. These processes were actually taking place in a broad chain of volcanic islands which extended from Northern Virginia to an area near Milledgeville, Georgia. Some of these mountains, mainly the non-volcanic ones, are estimated to have been over 30,000 feet in elevation. (The highest mountains on earth today, the Himalayas, are just over 29,000 feet.) However, over the years, most of them have been almost completely worn away by the forces of erosion.

The Uwharrie Mountains extend from southeastern Stanly County northeastward some forty miles to the Asheboro area, in a continuous belt of rocky ridges and cone-shaped hills. In order to understand why this area is different topographically from other areas in the Piedmont, one must consider the origin of the building blocks of the mountains – the rocks.

Geologists have found ample evidence deep in the earth that the Uwharrie Mountains were once part of a flat sea bottom. The tranquillity of this sea was disturbed by powerful forces within the earth that began, over 500 million years ago, to work drastic changes.

Easily seen, along the creek beds, in some road cuts, and at the bottom of the abandoned flagstone quarry located in the park, is the familiar gray slate used in the construction of many of the park's buildings. This slate and the weathered slate layers sometimes found above it, are proof that quiet water existed among the volcanic islands. Slate of this type is called argillite and resulted when volcanic ash formed muddy sediments in still water. The ash slowly settled to the bottom, forming bands of light and dark silt. As tremendous pressure developed from water and sediment layers above, the soft muddy sediments were transformed into shale. With more pressure, heat and time, the shale metamorphosed into the dense slate found throughout the park.

slate

It may have been during the latter part of the slate-forming era, still millions of years before the Age of Dinosaurs, that changes started to take place from inside the earth. Faulting, folding and metamorphism of pre-existing rocks occurred over a time period of 260 million years, stretching from the Ordovician period (505 million years ago) early in the Paleozoic Era to the Permian period in the later Paleozoic Era (245 million years ago). During this time, rock units were compressed and metamorphosed by at least three different mountain-building episodes. These episodes were caused by the collision of the Euro-African continent with North America. The results of these cataclysmic episodes are easily visible in the park for the slate layers are seldom found in a horizontal position, although they were certainly formed that way. Instead they are tilted, broken and faulted to the extent that the layers in the abandoned quarry are nearly vertical!

With the beginning of the Mesozoic Era, over 240 million years ago, the mountains of the Piedmont began to erode away. By the end of the Pliocene Epoch, 1.7 million years ago, the Uwharries looked very similar to how they appear today. The rocks which make up the

Uwharrie Mountains are Precambrian in age but the land surface created by the erosion is very young in geological terms. This is because the Uwharrie rocks were formed 500 million years ago. These rocks were buried under six miles of younger rocks which are now eroded away. Today the extrusive lava-formed rocks, basalt and rhyolite, are once again on the land's surface.

The basalt is found in the park as rounded boulders at the bottom of hills or on the hillside. It was formed when lava flowed, from volcanoes or cracks in the earth, then cooled quickly. Basalt is a heavy, grayish-green rock (green from the mineral chlorite) with a very fine grain.

Rhyolite is found on the tops of all the higher mountains in the Uwharries, where it has acted as a hard, protective layer. Its chemical composition is identical to the familiar granite, but granite has large crystals in its structure because it cooled slowly deep in the earth, allowing time for the crystals to grow. Rhyolite on the other hand, is very glassy in texture because, it was cooled too quickly for crystals to form. Rhyolite flows from a volcano only during very violent eruptions due to its very thick, viscous nature. It does not flow very far or form gas bubbles, and develops a very fine texture and extreme hardness upon cooling.

Because of its hardness and density, rhyolite deposits have resisted the erosion which cut away so much of the softer rock of the region. Nearly all the Uwharrie mountaintops have rhyolite boulders on them. The area's Native Americans broke up some of these rhyolite boulders to make tools, leaving the black, gray and white slivers of rock found on these mountains today. Rhyolite is the best natural material found in the southeastern United States for making stone tools which require a hard, sharp edge, such as spear and arrowheads, knives and scrapers. The first evidence of Native Americans in the area dates back to 10,000 B.C. – a long time ago by human standards but a mere moment in geological time.

Many visitors to Morrow Mountain enjoy the impressive view from the mountain's top. Morrow Mountain is only 936 feet above sea level but stands over 600 feet above the surrounding country side.

Sugarloaf and Hattaway Mountains, lying just north of Morrow Mountain, are well over 800 feet in elevation. Both are quite massive. Sugarloaf is composed of a rounded peak, a spur and a ridge extending southward to Morrow Mountain. Hattaway is an L-shaped ridge with the shorter axis extending westward. It has no definite summit, but rather a long ridge formation with occasional dips at stream heads. Rhyolite is less extensive on these mountains.

Fall Mountain, in the northern section of the park, has an unusual rhyolite formation called a dike. The dike extends northeast from this summit all the way across the Yadkin River. Such formations are caused by lava seepage through a large crack in the earth.

At the point where this dike of hard, erosion-resistant rock crosses the Yadkin River, the Great Falls of the Yadkin formed. This was the largest waterfall in the state in terms of volume of water. The early European explorer, John Lawson, visited this area in 1701 and described these falls as being very large and beautiful. Dr. Frances Kron, who lived in the house which is now part of the park's historical restoration, reported in his diary that the noise of the falls could be heard from his front porch, which is over a mile away and on the opposite side of Fall Mountain. Today, Alcoa's Falls Dam sits on top of the rhyolite dike and the falls are no longer seen or heard.

SCHEDULING WORKSHEET

Date request received_____ Request received by_____

1) Name of group (school) _____

2) Contact person _____ _____
name phone (work) (home)

_____
address

3) Day/date/time of requested program _____

4) Program desired and program length _____

5) Meeting place _____

6) Time of arrival at park _____ Time of departure from park _____

7) Number of students _____ Age range (grade) _____

8) Number of chaperones _____

9) Areas of special emphasis _____

10) Special considerations of group (e.g. allergies, health concerns, physical limitations)_____
_____

11) Have you or your group participated in park programs before? If yes, please indicate previous programs attended: _____
_____
If no, mail the contact person an Educator's Guide.

12) Are parental permission forms required? _____ If yes do you have these forms? _____
If not, mail contact person a Parental Permission form.

I, _____, have read the entire Educator's Guide and understand and agree to all the conditions within it.

Return to: Morrow Mountain State Park
49104 Morrow Mountain Rd.
Albemarle, North Carolina 28001

PARENTAL PERMISSION FORM

Dear Parent:

Your child will soon be involved in an exciting learning adventure - an environmental education experience at _____. Studies have shown that such "hands-on" learning programs improve children's attitudes and performance in a broad range of school subjects.

In order to make your child's visit to "nature's classroom" as safe as possible we ask that you provide the following information and sign at the bottom. Please note that insects, poison ivy and other potential risks are a natural part of any outdoor setting. We advise that children bring appropriate clothing (long pants, rain gear, sturdy shoes) for their planned activities.

Child's name _____

Does your child:

- Have an allergy to bee stings or insect bites?_____
  If so, please have them bring their medication and stress that they, or the group leader, be able to administer it.

- Have other allergies? _____

- Have any other health problems we should be aware of?_____
  _____

- In case of an emergency, I give permission for my child to be treated by the attending physician. I understand that I would be notified as soon as possible.

_____ _____
Parent's signature date

Parent's name _____ Home phone _____
(please print) Work phone _____

Family Physician's name _____ phone _____

Alternate Emergency Contact

Name_____ phone _____

NORTH CAROLINA PARKS & RECREATION
PROGRAM EVALUATION

Please take a few moments to evaluate the program(s) you received. This will help us improve our service to you in the future.

1. Program title(s) _____ Date _____
   Program leader(s) _____

2. What part of the program(s) did you find the most interesting and useful? _____
   _____

3. What part(s) did you find the least interesting and useful? _____
   _____

4. What can we do to improve the program(s)? _____
   _____
   _____

5. General comments _____
   _____
   _____
   _____

LEADERS OF SCHOOL GROUPS AND OTHER ORGANIZED YOUTH GROUPS
PLEASE ANSWER THESE ADDITIONAL QUESTIONS:

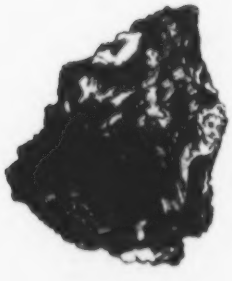
6. Group (school) name _____

7. Did the program(s) meet the stated objectives or curriculum needs? _____
   If not, why? _____
   _____

Please return the completed form to park staff. Thank you.

Morrow Mountain State Park
49104 Morrow Mountain Rd.
Albemarle, North Carolina 28001

Notes



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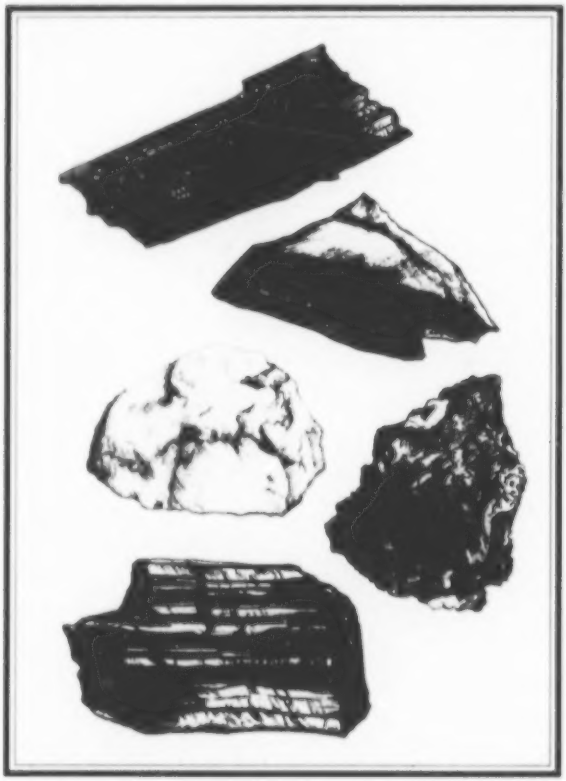
EDUCATOR'S GUIDE



Morrow Mountain State Park

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DEHNR

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Governor
4-93

Jonathan B. Howes
Secretary

Introduction to the North Carolina State Parks System

Since its creation in 1916, the North Carolina State Parks System has provided its visitors with opportunities for educational experiences and programs. Through the years, we have continued to revise and update our programming to make it more informative and more tailored to the needs of our state's school system.

Our state park system provides a wonderful outdoor classroom for learning about our North Carolina heritage. Each of our unique state parks offers a variety of environmental education opportunities which highlight our state's natural and cultural resources. All of our environmental education programs are designed to meet the curriculum requirements of the North Carolina Department of Public Instruction. Subject areas covered include science, social studies, arts, guidance, math, healthful living and communication skills.

The goal of our environmental education program is to generate an awareness in all individuals which cultivates responsible stewardship of the earth.

Introduction to Morrow Mountain State Park

Morrow Mountain State Park lies at the heart of the southern piedmont region of North Carolina known as the Carolina Slate Belt. This area was once covered by a shallow sea in which volcanic islands formed over 500 million years ago.

Although the inland sea islands and the lofty mountain range that the volcanoes eventually formed no longer exist, the rocks produced in this early period continue to play an important part in the appearance of the landscape today. The hard rocks produced by the lava flows, called basalt and rhyolite, have resisted the erosion of the Pee Dee River system more effectively than the softer volcanic slate that underlies much of the region. This difference in erosion rates has produced the steep hills known as the Uwharrie Mountains.

Archaeological research in the area has shown that Native Americans settled along the rivers of this region over 10,000 years ago. Excavated village sites show ample evidence, in the form of artifacts and burials, that large numbers of Native Americans occupied the area continuously until the 1720's. Early explorers who passed through the area described the Uwharries as a beautiful land of great trees, broad open savannahs and plentiful game, including elk, deer, bison, bear, cougar and wolf.

Around 1930 there was local interest in establishing a state park at Morrow Mountain. A committee was formed and bonds were issued for the purchase of land. The land was given to the state and the park opened to the public in 1935. Much of the early construction work, including the impressive stone lodge, was undertaken by the Civilian Conservation Corps during the Great Depression.

Program Options

A wide variety of outdoor educational programs is offered at Morrow Mountain State Park. Leaders may choose to conduct their own programs or to enlist the help of the park staff. The park's primary themes are geology, plant communities, water quality, cultural history and resource management. Programs in these and other areas are available to groups.

Morrow Mountain State Park abounds with natural history and is an excellent place to teach ecology, environmental issues, biology, conservation, earth science, literature, math and geology. The park's cultural resources provide a wonderful outdoor classroom for learning about the history of Native Americans and the first European settlers in this area. The park museum has displays on topics ranging from the formation of the Uwharrie Mountains to the land's first inhabitants.

The park's environmental education program is designed to provide learning opportunities using resources in the park. Students can experience the resources first-hand and understand the roles they play in our everyday lives. Groups are encouraged to visit the park during all seasons of the year for hikes, exploration, environmental education programs and activities. Outreach programs, in which the park staff visit the schools, are also available.

The Park's Cultural and Natural Resources

Kron House Restoration Area

Dr. Francis Kron was one of the first medical doctors in the southern piedmont of North Carolina. He and his family moved to Stanly County in the mid-1800's. His house, office and greenhouse have been rebuilt and are open to visitors throughout the year. North Carolina's largest Spanish chestnut tree, which Dr. Kron planted in the late 1800's, is found here.

Plant Communities

The variety of ecological niches at Morrow Mountain State Park is reflected in the diversity of plant species and forest types. Distinct and easily recognizable plant communities in the park range from the chestnut-oak forests on the dry, rocky mountain slopes, to the floodplain forest where the loamy soil is constantly moist. Other plant communities in the park include the oak-hickory forest, bottomland hardwood, pine forest, old fields and open marshlands.

Wildlife

Morrow Mountain is home to a wide variety of wildlife, ranging from the abundant white-tailed deer to small, inconspicuous insects found beneath the leaf litter. The diversity of habitats found in the park accounts for the many animal species. Among the most common mammals, reptiles and amphibians are fox, squirrel, skunk, bobcat, bats, spring peepers, black rat snake and marbled salamander. Birds abound in the park with many standing dead trees providing nesting cavities for such birds as woodpeckers, owls, wood ducks, and chickadees, while along the lakeshore, great blue herons, ospreys, many varieties of waterfowl and bald eagles are frequently seen.

Trail Descriptions

Three Rivers Self-Guided Trail: Although only 0.6 mile long, this circular trail offers more ecological diversity and wildlife-viewing opportunities than many longer trails. The path winds through a swampy woodland to the riverbank, skirts an open marsh, then tops a small hill. From there, you can overlook the junction where the Yadkin and Uwharrie rivers form the Pee Dee River. A trail booklet, rich with information on natural history, as well as historic and prehistoric occupation of the area, is available at the park office.

Laurel Self-Guided Trail: Many common trees of the upland hardwood forest are identified in the booklet accompanying this 0.6 mile circular trail that begins at the museum. In addition to mature oaks and hickories, the trail offers a hillside view of Sugarloaf Branch and winds through stands of pines which mark the location of old fields. Mountain laurel and pinxter flowers (azaleas), flowering in May, are abundant on approximately half of this trail. Obtain the trail guide at the park office.

Quarry Trail: A 0.6 mile walk (one way) along this trail affords an opportunity to view the bedrock that makes up this area. The twisted, upturned layers of volcanic slate, exposed by quarrying activities, are mute testimony to the cataclysmic formation of the Slate Belt some 400 million years ago. The bottom of this man-made gorge now harbors a heavy growth of ferns and moisture-loving wildflowers.

Hattaway Mountain Trail: This 2 mile trail takes the hiker up the steep slopes of Hattaway Mountain, the third highest peak in the park. The mature forest of chestnut oaks and sourwoods along the flattened summit of Hattaway is typical of dry, rocky ridges in the Uwharrie Mountains.

Rocks Trail: This 2.6 mile trail leads to a 35 foot high rock outcrop overlooking the Pee Dee River. Dense thickets of mountain laurel are found near the trail's end.

Trail Descriptions

Mountain Loop Trail: This loop trail starts and ends at the picnic area on the summit of Morrow Mountain and winds for 0.8 miles through the chestnut-oak forest and across two ridges as it circles the top of the mountain.

Sugarloaf Mountain Trail: The large field at the beginning of this 2.8 mile trail is an excellent place to see white-tailed deer, red-tailed hawks and songbirds. Climbing the slopes of Sugarloaf, the park's second highest mountain, the observant hiker can see the typical sequence of rocks found on volcanic peaks in the Uwharries: volcanic slate at the bottom, tuff (volcanic ash) on the mountain sides, and a hard, erosion resistant cap of rhyolite (volcanic flint) on the summit. The steep trail that completes the loop affords fine views of the valley of the Pee Dee River and Tater Top, a conical hill at the foot of Morrow Mountain.

Fall Mountain Trail: At 4.1 miles, this rugged circular trail offers more of a wilderness experience than the other trails in the park. Many interesting flowering shrubs including mountain laurel, horse-sugar, pinxter flower (azalea) and witch hazel can be found on Fall Mountain. Cliff-like rock outcrops afford good views of the Yadkin River. Along this portion of the trail, one has an especially good chance of seeing such attractive birds as the kingfisher, great blue heron, osprey, wood duck and the pileated woodpecker. Hiking boots are recommended for crossing the sharp fragments of rhyolite near Falls Dam.

Morrow Mountain Trail: Begin at the museum parking area and hike this 3 mile trail to the summit of Morrow Mountain. This trail utilizes portions of three other trails: Laurel Trail, Sugarloaf Mountain Trail and Mountain Loop Trail. It offers a secluded hiking experience through mature hardwood forest, crossing streams, and concluding with a strenuous 0.25 mile hike up the steep slopes of Morrow Mountain.

Scheduling a Trip to Morrow Mountain State Park

Groups are encouraged to visit the park during all seasons of the year for hikes, exploration, environmental education programs and activities. Leaders may choose to conduct their own activities or enlist the help of the park staff.

To Make a Reservation

Because our Environmental Education Learning Experiences involve additional park staff, it is necessary to contact the park at least one month in advance. For other types of programs, including special requests, please contact the park at least two weeks in advance.

Please provide the following information:

- Name of group (school).
- Name, address, work and home telephone numbers of the group contact person.
- Date and time of arrival and meeting place at the park.
- Departure time from the park.
- Number of participants and adult leaders. *(A maximum of 30 participants is recommended. Please have one adult leader per 10 students. Adult leaders are responsible for maintaining control of the group).*
- Age range and/or special needs of the participants.
- Desired activities; assistance from park staff.

Bad Weather Policy and Cancellations

Our Environmental Education Learning Experiences are held outside. If weather conditions preclude us from conducting the program outside, we will provide a modified program at the park office. If you make a reservation for an Environmental Education Learning Experience (or another program) you may come regardless of the weather or we can reschedule if you desire. *If you wish to cancel or reschedule, please notify the park office as soon as possible.*

Before You Make the Trip

1. Complete appropriate pre-visit activities in the Environmental Education Learning Experience packet.
2. Visit the park without the participants prior to the scheduled group trip. This will give you a chance to become familiar with the park facilities and staff, and provide you with an opportunity to identify potential problems.
3. Discuss behavior expectations with adult leaders and participants when planning the trip. Discuss the park rules listed and emphasize safety.
4. Inform your group about poison ivy, ticks, snakes and insects. Discuss the need to use insect repellent from late spring through early fall.
5. Inform the group of the need to dress appropriately for the season. Shoes suitable for walking should be worn.
6. Have everyone wear a name tag. For safety, please color code them by groups. A buddy system for younger students is encouraged.
7. *Group leaders are responsible for obtaining a consent form from each participant, including a list of any health considerations and special medical needs.* These forms are available at the park office and from the Environmental Education Learning Experience packet.
8. If your group plans to collect any plant, animal or mineral within the park, a Research Activity permit is required. Contact the park office to obtain a permit application at least 30 days in advance of your visit.
9. Assigning jobs to students and/or leaders is recommended. Leaders could be responsible for lunches, moving groups from one area to another and enforcing rules.

While at the Park

Please obey the following rules:

1. To help you get the most out of the experience, and increase the chances of observing wildlife, be as quiet as possible.
2. On hikes, walk behind the leader at all times. Assign an adult leader to be last and keep the group between these two people. Stay on designated trails and do not run.
3. All plants and animals within the park are protected. Harming or disturbing plants and animals is prohibited in all State Parks. This allows all visitors the same opportunity to enjoy our natural resources.
4. Picnic only in the designated picnic areas. Help keep the park clean and natural; do not litter.
5. In case of accident or emergency, contact the park staff immediately.

Following the Trip

As soon as possible after the trip:

1. Complete the post-visit activities in the Environmental Education Learning Experience packet.
2. Build upon the field experiences and encourage participants to seek answers to questions and problems encountered at the park.
3. Relate the experience to classroom activities and curriculum through reports, projects, demonstrations, displays and presentations.
4. Give tests or evaluations, if appropriate, to determine if the students have gained the desired information from the experience.
5. File a written evaluation of the experience with the park. Evaluation forms are available at the park office and from the Environmental Education Learning Experience activity packet.

Park Facilities

Restrooms: Restrooms are available at the picnic areas, swimming pool, boathouse, park office and campground.

Picnic Areas: Picnic areas with tables, shelters and grills are located at the top of Morrow Mountain and at the swimming area parking lot. Shelters may be reserved for a modest fee, or are available on a first come basis free of charge.

Family Camping: Family camping is available year-round on a first come basis. Each site has a grill, picnic table, trash can and gravel pad for vehicle parking; drinking water and modern shower facilities are located nearby. Electrical and water hookups are not available. The shower facilities are closed December 1 to March 15, but drinking water and pit toilets are provided.

Group Camping: The group camping area, which has drinking water, pit toilets and picnic tables, is available by reservation. Groups are not allowed to stay in the family campground.

Backpack Camping: Backpack camping is available. Check with a ranger for registration procedures.

Swimming: The swimming pool area is open June 1st through Labor Day and is accessible to the physically disabled. The pool area includes a modern bathhouse and concession stand.

Boat Rentals: Rowboat and canoe rentals are available from June 1st through Labor Day.

Museum: A small museum containing information on geology and cultural and natural history is available to your group upon request.

Lodge: The lodge is a large building constructed by the Civilian Conservation Corps (CCC) and Works Progress Administration (WPA). The park office is located here. The building is used for programs in inclement weather conditions.

Cabins: There are six fully-equipped vacation cabins that may be reserved.

Park Information

Location: Morrow Mountain State Park is located in Stanly County, 6 miles east of Albemarle and is accessible from NC highways 24/27, 73 and 740.

Address:

Morrow Mountain State Park
49104 Morrow Mountain Road
Albemarle, North Carolina 28001

Telephone:

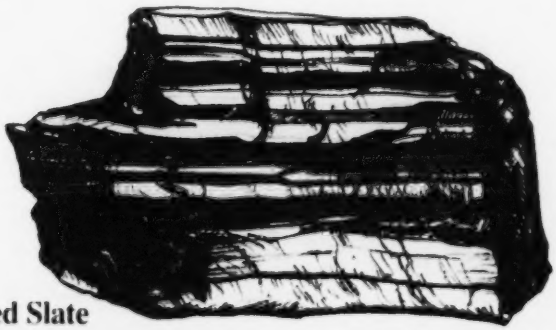
(704) 982-4402

Office Hours:

Monday - Friday, 9 a.m. to Noon

Park Hours:

November - February	8:00 a.m. to 6:00 p.m.
March, October	8:00 a.m. to 7:00 p.m.
April, May, September	8:00 a.m. to 8:00 p.m.
June - August	8:00 a.m. to 9:00 p.m.



Weathered Slate

Morrow Mountain State Park

LEGEND

- Amphitheater
- Boat Launch
- Boat Rentals
- Boundary Line
- Bridle Trail
- Dump Station
- Family Camping
- Family Vacation Cabins
- Group Camping
- Hiking Trail
- Information
- Museum
- Park Office
- Picnicking
- Primitive Camping
- Ranger Residence
- Road-Gravel
- Road-Paved
- Stanly Memorial Hospital 704-983-4480
- Swimming Pool

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AFTER HOURS EMERGENCY PROCEDURES

Park gates are locked at specific times which vary with the seasons. Should an emergency arise after the gates are locked, there is a pay phone outside the park office. Emergency procedures are posted beside the phone.

Hiking Trails

Fall Mountain:	4.1miles, moderate
Hattaway Mountain:	2 miles, strenuous
Laurel:	6 miles, easy
Morrow Mountain:	3 miles, moderate
Mountain Loop:	.8 miles, easy
Quarry:	6 miles, easy
Rocks:	2.6 miles, easy
Sugarloaf Mountain:	2.8 miles, strenuous
Three Rivers:	6 miles, easy

All bridle trails may be used for hiking.

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Educational Activities Available at Morrow Mountain State Park

Morrow Mountain State Park
49104 Morrow Mountain Rd.
Albemarle, North Carolina 28001
Telephone: (704) 982-4402

The following is a list of educational programs offered by park staff at the park and as outreach programs. Ask park staff about new programs that may have been added to the list.

OLD AS THE HILLS
An Environmental Education Learning Experience

DANGER! Unwary students may have fun while learning.

The environmental education learning experience, Old As The Hills, focuses on the geology of the Uwharrie Mountains and Morrow Mountain State Park. It includes an Educator's Activity Packet designed to provide environmental education through a series of hands-on activities, educator and student background materials, vocabulary, lists of curriculum areas and measurable objectives, references and worksheets. Developed for grades 5 - 7, the activity packet offers environmental education while meeting established curriculum objectives of the North Carolina Department of Public Education in a variety of subject areas. Activities include pre-visit, on-site and post-visit activities. Students will be exposed to such major concepts as rock formation, weathering, resource management and preservation. Time required varies depending upon activities chosen.

Other Programs

The programs listed below may be geared to any grade level and last approximately 1 hour.

Three Rivers Nature Trail Hike
A self-guided or ranger-guided hike that introduces the unique early settlements in the area, as well as the abundant wildlife of the Uwharrie Mountains.

Kron Restoration Area
Visit the old homesite of Dr. Kron and his family, who lived here in the 1800's. Dr. Kron was the first medical doctor in this area and was an avid horticulturist.

Raptors
Curious about our national bird? Find out more about the bald eagle and other birds of prey, such as hawks and owls.

Native Americans
Learn how Native Americans lived in this area before the arrival of European settlers..

Plant Ecosystems
Can't see the forest for the trees? Discover the different forest types found in the park and the special requirements for each.

The White-tailed Deer
Learn how the abundant white-tailed deer survives and adapts through the changing seasons.

Reptiles and Amphibians
Get acquainted with some of the 58 different species of reptiles and amphibians at Morrow Mountain State Park.

Reading Animal Signs
Learn how to identify and read animal signs while exploring those left along the Pee Dee River.

Aquatic Life
Learn about the fascinating life found in the waters in and around Morrow Mountain State Park.

Bird Life
Want to learn more about our feathered friends? This program introduces you to the basics of studying birds, their habitats and adaptations.

Other programs are available on a wide range of topics. Our professional park staff will also develop a special program for your group upon request. Call the park office for further details.